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LECTURE.

Friday, January 17th, 1873.

Admiral Sir ALEXANDER MILNE, G.C.B., Lord of the Admiralty, in the Chair.

POWDER PRESSURES IN THE FIRST 35-TON GUN.

By Commander W. Dawson, R.N.

"*With hard projectiles having * * * * studs, there will generally be a slightly oblique movement of the axis of the projectile.*"—Modern Artillery.

"*The gun rifled on the French*" (Woolwich) "*system has decidedly the lowest velocities.*"—Ordnance Select Committee, 1864.

"*It is the maximum pressure which causes the failure of the stud.*"—Sir W. G. Armstrong, 1870.

The Chairman: Gentlemen, having been requested by the Council to take the chair at this, the first meeting of the year, it affords me great pleasure to do so, because I have always felt that this Institution has been of great value to both our Services. I think it is only right for me to say, that the lecturers who have appeared before us here on previous occasions, have not only benefited the Institution, but have conferred a general benefit on the Services at large. I do not attend here to-day in my official capacity, but I come here as your Chairman, to act independently in that capacity, and so doing, I have very great pleasure in introducing to your notice Commander Dawson, who will now proceed to deliver his lecture.

Commander Dawson: The Surveyor-General of the Ordnance observed, 2nd March, 1872, "that he should be glad if the Committee turned their attention to the remarkable results of firing large charges of pebble-powder. He has never been satisfied with the discrepancies as to the amount of pressure produced by a comparatively small increase in the charge of powder."* The Committee on Explosives report, 1st April, 1872, that "*When*

* See "Extracts from the Proceedings of the Department of the Director of Artillery," vol. x, Part II, page 86.

"*a charge of any description of powder* is increased beyond a certain limit, wave or local pressures are set up which strain the "gun unduly, *without affording an equivalent of useful effect on the* "*projectile*." And the Special Committee report, 12th February, 1872, "that heavy guns, proved under the existing regulations, "are subjected to very undue local pressures, resulting in local en-"largements, dents, and even occasionally in cracked tubes."† * * "The Committee are perfectly aware of the great strength of our "heavy guns, and of the fact that they do stand the existing proof "without danger of bursting, but they cannot consider the local "enlargements of the bore, the dents, &c., which frequently occur on "proof, as at all desirable."‡ The "proof" charges here referred to, except in the case of the 35-ton gun, are $1\frac{1}{4}$ times those diminished weights of gunpowder, which are mis-called "battering charges," and are fired horizontally with the ordinary service projectiles. After "proof," and during cool training-practice with reduced charges, similar liabilities obtain, so that Inspectors of Ordnance are appointed to register the damages inflicted upon the bore during the exit of every fifty projectiles. These Inspectors are told in the *Official Text Book of the construction and manufacture of the rifled ordnance in the British Service*, corrected up to January, 1872, p. 175, that "there are certain "defects to which all guns are liable, such as 'tool marks,' or "irregularities in the boring and rifling during manufacture; 'dents' "or 'abrasions,' caused by the bursting of a shell in the bore; and "wearing at the sides of the 'grooves' from the friction of the studs of "projectiles." "Woolwich" rifled guns are also liable to erosion from the escaping gases, or hard, deep, roughness in the lands and grooves over, and in front of, the seat of the projectiles. The studs and the walls of the projectiles are also liable to certain marks and injuries of so serious a nature, that every recovered service projectile has to be destroyed§, and the "proof" ones restudded.

It seems not impossible that some connection may obtain between the Surveyor General's question about "the discrepancies as to the "amount of pressure produced by a comparatively small increase in "the charge of powder," and the "dents," "abrasions," "local "enlargements," and roughnesses of the bore, alluded to by the Special Committee; as well as with the shearing or wedging of the studs and the base-marks and compression of the walls of the projectile referred to elsewhere by the talented Superintendents of the Royal Gun Factories and of the Royal Laboratory, and in the official work on *Ammunition*, part II, pages 58, 73, &c. This idea seems not unreasonable, as the learned Professor of Artillery points out that "with hard pro-"jectiles having * * * * studs, there will generally be a slightly "oblique movement of the axis of the projectile." The force of this wriggling action would naturally increase with the greater violence of

† See "Extracts from the Proceedings of the Department of the Director of Artillery," vol. x, Part II, page 81. ‡ Ibid., page 85.

§ The recovered projectiles, whether chilled or not, are sent to the Royal Laboratory, where the brass studs are drilled out—a costly operation—and the old iron is then returned to the furnace.

large powder charges, and with the obstructions experienced by the studs of the escaping projectile. This view is further confirmed by comparing the Report of the late Ordnance Select Committee upon a large number of similar 7-inch projectiles fired under identical conditions except as to the agency for producing rotation, that the gun rifled "on the French (Woolwich) system, has decidedly the lowest velocities" * with the damaged condition of 70 per cent. of the recovered studded shell and the position of the injuries to the lands and grooves of the gun which had thus absorbed within its bore the force represented by the difference between the speed of the fastest competitive shot and of the studded one which had "decidedly the lowest velocities." (See Plate III.)

The History of the late 35-*ton Gun.*—The powder pressures registered in the late 35-ton gun afford the best known means of investigating Sir Henry Stork's problem. Of no other heavy gun, has the history of its conception, manufacture, trial, and failure been so carefully registered and published. Though the official examinations do not appear to have extended to the recovered projectiles, and those of the bore do not appear to have been made with scientific exactitude, until the gun gave way, yet the published register of each of the 73 rounds fired, with the corresponding pressures, is full of fruitful lessons.

The Intended Charge.—From "the Report of the Ordnance Council "on the proposed 35-ton gun competition," 4th May, 1870, we learn that Colonel F. A. Campbell, R.A., the talented Superintendent, Royal Gun Factories, designed the 11·6-inch bore for *a charge of* 120 *lbs. and a* 700-*lbs. projectile.* Sir W. G. Armstrong and Co. also proposed "*a charge of* 120 *lbs. of powder*, and a projectile weighing 700 "lbs. for this (12-inch) gun;" adding, "but we are willing *that any* "*charge* and weight of projectile which may be used with a competing "gun of equal weight, should be used also with our gun." Sir William Armstrong further "points out that in future, where much milder "powder will be used, the strain upon the studs will be proportionally "less, because, *of course, it is the maximum pressure which causes the* "*failure of the stud*, and as you reduce the maximum pressure, so you "increase the stability of the stud." Sir Joseph Whitworth substantially agreed with these two great artillery authorities as to the power of useful powder-consumption to be expected from the 35-ton gun, inasmuch as he fixed the powder charge, for such a 12-inch gun with polygonal rifling, at 117 lbs. with 750-lbs. projectiles, his proposed armour shells being $3\frac{1}{2}$ and 5 diameters long, of 880 and 1,250 lbs. weight, and containing 36 lbs. and 58 lbs. bursting charges respectively, instead of the $8\frac{7}{8}$-lbs. bursters now used.

The Present "Proof" Charge.—The powder charge now adopted has been reduced from 120 lbs. to 110 lbs. and 85 lbs. of the "milder powder," with projectiles of 700 and 616 lbs. in weight. Moreover, even these reduced charges are intended to be very sparingly used, for the second 12-inch 35-ton gun had been, at the end of the year, eight months at Shoeburyness for range finding, and had only fired

* See "Extracts from Reports, &c., Ordnance Select Committee," vol. ii, p. 292, sec. 13.

nineteen 110-lbs. reduced charges at low elevations and at considerable intervals of time, besides 46 small 85 lbs. P. charges. It appears also that, even for the "proof" of 35-ton guns, two rounds of service shot with reduced charges are alone used; though the usual proof in other heavy guns is two rounds with service shot, and $1\frac{1}{4}$ times the amount of powder in the highest service charge. But we are officially told that this latter test results, in other guns, "in local enlargements, dents, and "even occasionally in cracked tubes." And, the official "*Extracts of "Artillery Proceedings*" tell us, 4 : 3 : 72, that the Superintendent, Royal Gun Factories, "proposes that the proof charge for the 12-inch "gun of 35-tons shall be 115 lbs. To this the Committee have no "'objection, believing that two rounds of such a" reduced "charge "will not be a dangerous proof. He also concurs with the Committee "in thinking it advisable that the proof of heavy guns should com- "mence with a service charge. Therefore, the proof of the present "pattern 12-inch gun of 35-tons would be:—

"1 round, 110 lbs. pebble powder"
"1 round, 115 lbs. pebble powder"*

The gun having been designed to fire ordinarily, with elevation, and quick firing against a foe, 120 lbs. of powder.

"Projectiles of service weight being used in each case."

It will be observed that this "proof" with two reduced charges does not include firing with elevation, with heated chamber, with violent quick-burning powder, such as it may be necessary to employ on service, or with projectiles longer than 2·61 calibres capable of containing only $8\frac{7}{8}$ lbs. bursters. In other words, not only does the maximum test come short of what the gun was originally designed to endure in ordinary service, but it also comes short of what the gun would still have to endure in an ordinary naval bombardment, using the reduced charge of 110 lbs. at high elevations, in continuous and rapid firing.

Lack of Endurance.—The ostensible cause of this reduction of powder-charge, and weight of common shell, is the irregular and excessive pressures registered in the chamber of the first 35-ton gun. But the real cause is the very limited and sickly life endured by the grooved portion of the bore of that gun. Whether this limited endurance of the grooves and lands be the cause or the effect of the erratic pressures within the powder chamber, is questioned. A brief life might, however, have been predicated for this gun, not only from a consideration of the inverse ratio of endurance to weight in other "Woolwich" ordnance, but also of the evidence given by the Superintendent of the Royal Gun Factories before the Ordnance Council, which assembled at the War Office on the 4th May, 1870. This Officer stated very clearly his misgivings as to the system of rifling to be adopted, and the difficulty of thus rotating efficiently a sufficiently long projectile without such an increase of grooves as would be most prejudicial to the gun. He said:—"The stud in the projectile confines us to giving a less twist "than I should like to give to any gun. * * * * In heavy guns the "liability to shear, necessitates an increased number of grooves if a

* Possibly *two* rounds of 115 lbs. P. and one 110 lbs. P. are intended.

"quicker twist than now employed is given. *The system has the great* "*disadvantage of local scoring.*"

Milder Powder and Studs.—True, Sir William Armstrong unprophetically expressed "the greatest possible confidence that, with an "accelerating twist and the milder form of powder that will hereafter "be used, there is nothing to apprehend whatever from the stud "shearing. * * I think they have stood perfectly well, and in "standing perfectly well as they have done, we have a guarantee that "they will stand better in future, because the strain upon them will "be so very much lighter, not only from the milder powder, but from "the mode of rifling;"* quite ignoring the fact, that the same sized stud is used to support and rotate a 700 lbs. shot as one of 115 lbs. weight.

Colonel Campbell does not appear to have shared either Sir William Armstrong's confidence as to the "milder powder," nor as to the endurance of the studs, stating that "the stud on the projectile confines "us to giving a less twist than I should like to give to any gun. * * "We are afraid on account of the shearing of the stud. * * * I "have seen them shear as much as" one-tenth of an inch, "and for that "reason I should be afraid to give a greater twist than I have."† Being cross examined as to his experience of studs, Colonel Campbell maintained his convictions as to the evil influence of short-bearing studs on rotation, and hence upon endurance.

The 11·6 *inch* 35-*ton Gun.*—The 11·6 inch 35-ton gun was built and rifled with an accelerated twist on the French stud, or so-called "Woolwich" system.

During the first four months of 1871, thirty-five 11·6 inch 700-lbs. shot were projected horizontally with charges of 75, 100, 110, 115 and 120 lbs. of W.A.P. and Belgian P. powder—one discharge, the 8th, being with 130 lbs., or ten pounds more than that originally intended. No great mischief to the gun appears to have resulted from this four months' work. The condition of the shot is not stated.

The 12-*inch Bore.*—The barrel was then bored up to 12 inches. By taking a shaving of two-tenths of an inch off the inside, the roughnesses and abrasions in the interior were erased, and the bore came out of the factory with a polished surface like a new gun. For all practical purposes the 12-inch bore may be safely regarded as making the 35-ton gun a new weapon.

During the three-and-a-half months, ending with the last day of January, 1872, thirty-eight 12-inch 700-lbs. projectiles were fired horizontally from this new bore, with 110, 115 and 120 lbs. W.A.P. and Belgian P. charges.

"At a weekly meeting held at the War Office, 6th February, 1872, "it was decided to recommend that no further trial of this gun should "be made at present." And some weeks later, the gun was removed into the factory, where its B. tube or chase was cut off, its interior steel barrel and its cascable bored out, and a new interior steel barrel, a new

* See Parliamentary paper, No. 308 of 1870, "Report of the Ordnance Council on the Proposed 35-ton Gun Competition," page 13.

† Ibid., pages 11, 12.

cascable, and a new B. tube or chase substituted. Thus rebuilt, the gun will probably be as capable as before of enduring 38 horizontal discharges, spread over three and a half months.

The Practice Table.—The Report of the Committee on Explosive Substances, dated 1st April, 1872, has appended to it two very valuable though incomplete documents. One of these is a Practice Table, giving the detail of each of the 73 rounds fired from the 35-ton M.L.R. gun, showing the brand and weight of powder and the point of ignition in the cartridge, with the corresponding observed velocities at 110 and at 132 feet; and the maximum pressures registered by crusher-guages at (A) the inner end of the bore in line with the axis, at (B) the vent, 12 inches outwards, and at (C) the base of the shot, which should sustain the greatest pressure when it has advanced about six inches from its seat, or (with 120-lbs. charge) about 33½ inches from the inner end of the bore. I have divided this table into two parts for the 11·6-inch and for the 12-inch bores respectively, and I have added a column showing the correspondence, or, rather, lack of correspondence, between the expulsive pressure exerted upon the base of the projectile, and the striking force resulting therefrom at 110 feet from the gun.

The State of the Bore.—The other valuable document appended to the Committee's Report is the result of special examinations of the state of the interior before firing at all, and after the 6th, 8th, 20th, and 29th round with the 11·6-inch bore. These examinations do not appear to have been made with scientific exactitude, yet the pressures agree very fairly with the reported state of the bore. But no examination took place before boring out all the hard, deep roughnesses made by the gases in the lands and grooves, the local enlargement of the barrel, and the burrs on the edges of the grooves, *i.e.*, in the process of conversion into a 12-inch gun. Official examinations were made of the 12-inch barrel before firing, and of the damages inflicted upon it, whilst discharging 12, 33, and 38 projectiles.

I have summarised the Reports of these examinations in a column appended to each Practice Table, so as to place the pressures and the state of the bore in juxtaposition, and I have prepared Plate I to illustrate the longitudinal position of the principal injuries found in the interior of the 12-inch bore after the last discharge. The position of the damages are shown in the Plate by dark shading for the greatest enlargement and by thick lines for the other injuries, which are placed at the correct distances from the inner end of the barrel (A); but their vertical position could not be shown on a half section, and their *nature* could not be made visible on so small a scale. The Plate also shows the position of the shot,—1st, when in its seat; 2nd, when advanced six inches, where its base would register the highest pressures; and, 3rd, when advanced eight inches, where the rear-stud comes into "driving" bearing. The crusher-guages are shown (A) at the inner end of the bore, where the highest pressures were usually registered; (B) at the vent 12 inches from A; and (C) in the base of the shot six inches in advance of its seat. The principal injuries are:—

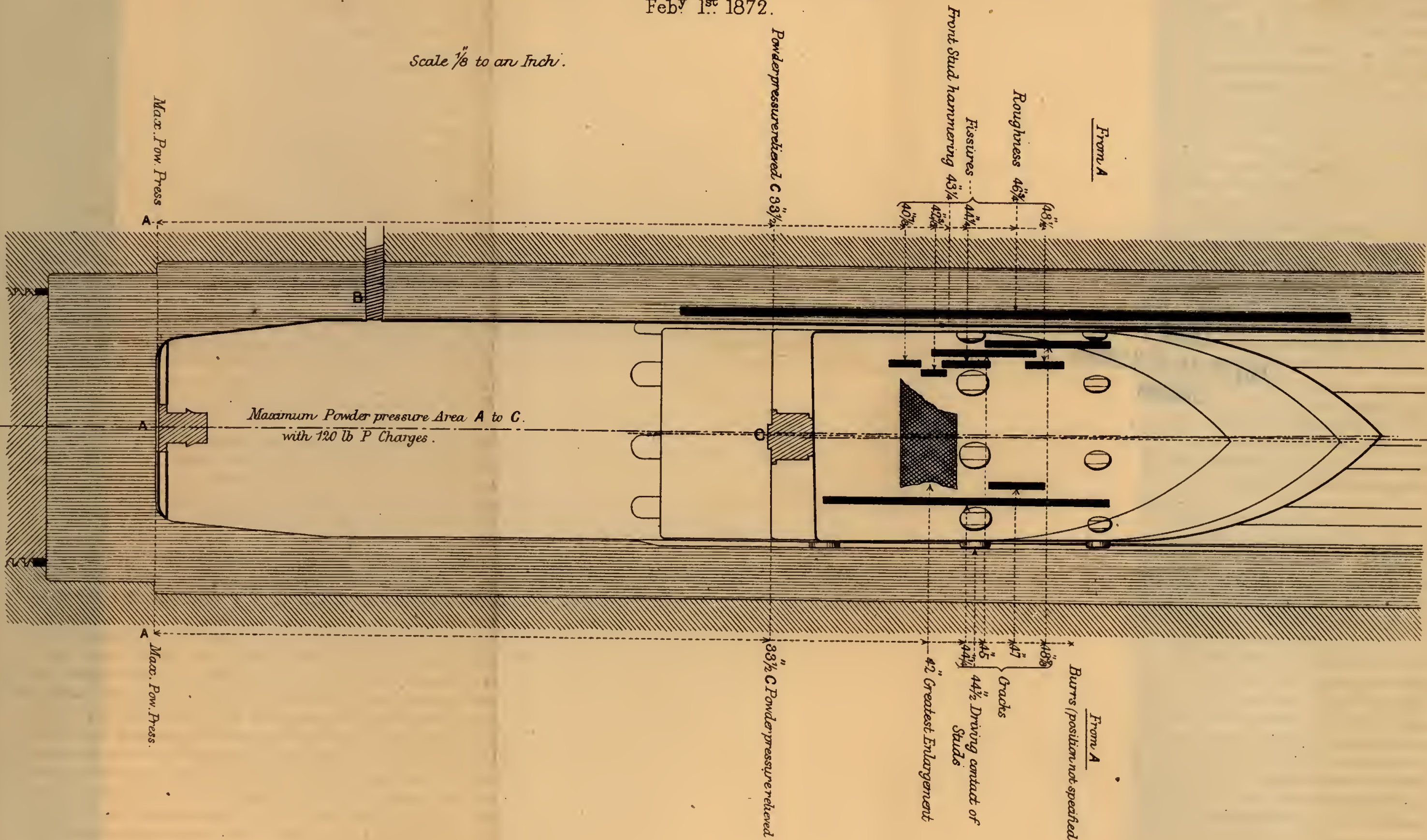
Journal R. U. S. Institution
Vol. 17.

Interior of
THE FIRST 12 INCH 35 TON M.L.R. GUN, AFTER 38 DISCHARGES.

The rear stud coming into "driving" bearing

Feby 1st 1872.

Scale 1/8" to an Inch.



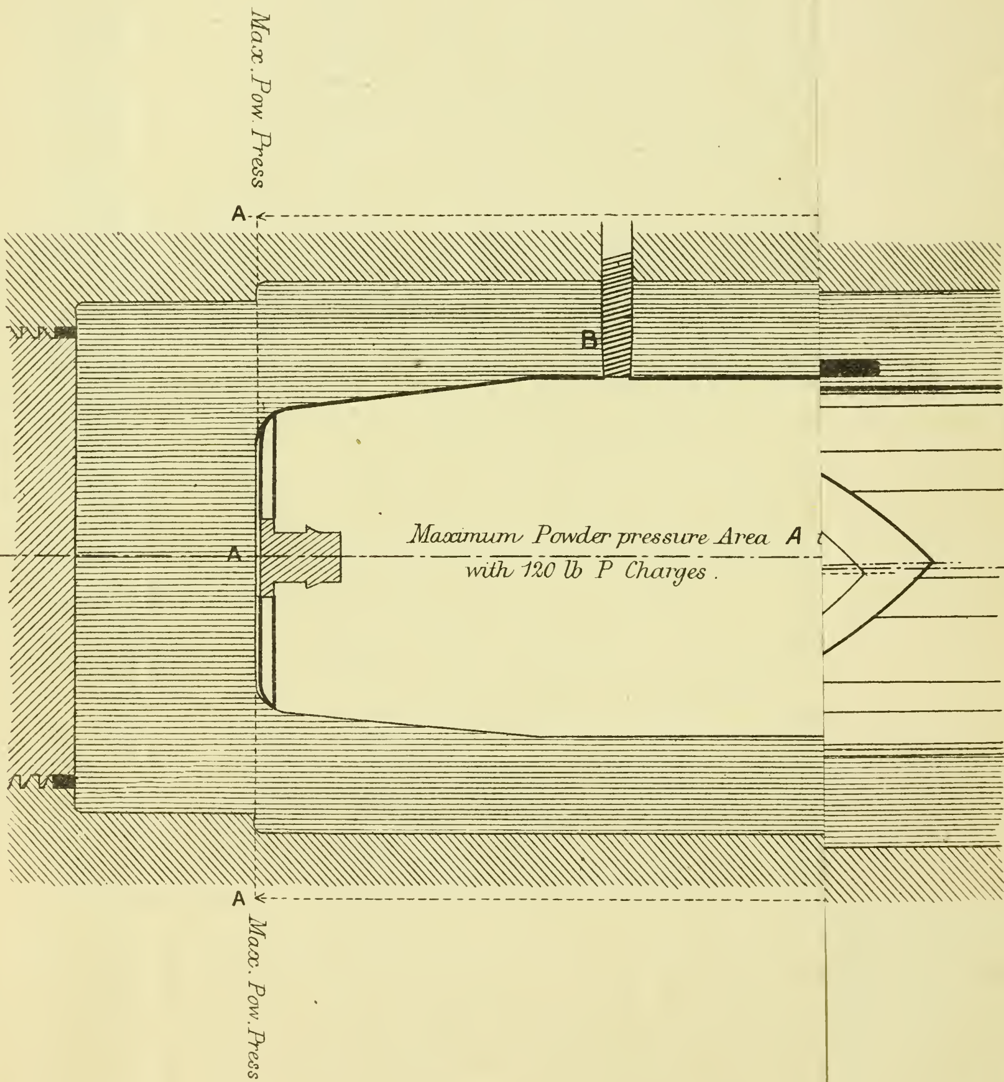
J. Jobbins

Journal R. U. S. Institution
Vol. 17.

Pl. I.

THE

Scale 1/8" to



J. Jobbins

State of the 12-inch bore, 1st February, 1872. See Plate I.	Distance from (A) inner end of bore. Extremes.	Centre.	Vertical position in the bore.
Longitudinal crack *in edge of groove*......	$36\frac{1}{2}$ to 52 in.	$44\frac{1}{4}$ in.	R. of down
" " " "	$45\frac{1}{4}$ to 52 "	$48\frac{5}{8}$ "	R. of up
" " centre of groove ..	$45\frac{1}{2}$ to $48\frac{1}{2}$ "	47 "	L. of down
" " " "	$42\frac{1}{4}$ to $47\frac{3}{4}$ "	45 "	L. of up
Slight fissures in centre of groove........	$41\frac{3}{4}$ to 43 "	$42\frac{3}{8}$ "	Up
" " "	40 to $41\frac{3}{4}$ "	$40\frac{7}{8}$ "	L. of up
" " "	$47\frac{1}{2}$ to $49\frac{1}{2}$ "	$48\frac{1}{2}$ "	Up
" " "	43 to $45\frac{1}{2}$ "	$44\frac{1}{4}$ "	Up
Greatest enlargement ·029 inches	$40\frac{1}{2}$ to $43\frac{1}{2}$ "	42 "	Round
Roughness in lands and grooves	$28\frac{1}{2}$ to 65 "	$46\frac{3}{4}$ "	Above
Burrs on edges of grooves	not	given	
Rear stud in seat........................	According to length of cartridge	$35\frac{1}{2}$ in.	Down
Rear stud in "driving" bearing		44 "	Round
Front stud in seat and hammering		43 "	Up
Maximum P. powder pressure area		0 to $33\frac{1}{2}$ "	—

I should add, that it is generally understood that the report of the condition of the bore made when the gun was disabled, which is appended to the Committee's Report, does not altogether correspond in every detail with what was ascertained during the process of rebuilding. But, I am told, that the differences between the published Report and the subsequent examination, do not materially affect my argument. For no injury whatever has been discovered within the powder chamber or within the maximum powder-pressure-area, which extends to about 34 inches from the inner end of the bore where the highest pressures are registered; thereby showing that no injury whatever has resulted to the gun from the direct action of the maximum powder-pressures. Nor, as I understand, do these unpublished details vitiate the official examination made on the 1st February, 1872, the day after firing the last shot, as regards the longitudinal position of the damages, which are from $36\frac{1}{2}$ to 52 inches from the point of maximum pressure at the inner end of the bore.

The "Driving" Contact of Rear Studs (Plate I).—The point where the front studs would strike, and where the rear studs come into "driving" bearing, tallies very remarkably with these injuries; for the shot moves eight inches from its seat, and attains about one-third of its velocity before the rear studs strike the "driving" edges of the grooves, the shot moving then with a striking force of 1,800 foot-tons. Now, the seat of the projectile and, consequently, the point where the rear studs come into "driving" bearing, and inflict a portion of this 1,800 foot-tons' blow, varies with the length of the cartridge. But, with the 120-lbs. charge, it is 44 inches from the point of highest pressure at the inner end of the bore. And if we suppose the operation of shearing off the rounded edges of the rear studs, and of wedging the gun-metal over the edges of the grooves, and of printing base marks

into the iron projectile, to be spread over a few inches of the shot's progress, the place in the bore where these suicidal operations would naturally be performed, corresponds with singular faithfulness to the central points of the four cracks, and the four slight fissures in the grooves, and with the maximum enlargement of the barrel.

The position of the burrs on the edges of the grooves is not given ; but it is physically impossible that the rear-studs could make these burrs within the maximum powder-pressure-area, for they must then do so in rear of their own seat. It is most likely that the burrs are at, and in advance of, the point where the rear-studs strike their portion of the 1,800 foot-tons' blow upon the edges of the grooves, and commence to shear and override or wedge on the lands.

The roughness of the bore naturally begins above the seat of the base of the projectile, and therefore extends six inches within the maximum powder-pressure-area. Colonel Campbell ascribes " the great disad- " vantage of local scoring " to " the system " of rifling. This serious evil is caused, in the initial stages of combustion, by the rushing gases, in their effort to escape *over* the shot through the windage space, and through the wide, deep, almost-unoccupied upper grooves. This " local scoring " doubly effects the pressures, first, by striking down the base of the shot, nicely balanced on two points nearly under the centre of gravity, striking the front stud against the centre of its groove, and setting up a vertical " oblique movement of the axis of the projectile;" and, secondly, by roughening, like the bark of an elm tree, the surface which the studs have to traverse, thus impeding their exit, inducing shear and wedging, and enhancing the force of the "oblique movements" about the rear-studs.

Whatever be the cause, the position of every injury in the 12-inch bore is just in advance of the seat of the studs, outside the maximum powder-pressure-area, $3\frac{1}{2}$ to $4\frac{1}{2}$ feet from the point where the highest pressures were registered (See Plate I), and at a place where they would naturally obstruct the free exit of a non-centering projectile, liable to that " wriggling " action which the learned Professor of Artillery euphemistically styles an " oblique movement of the axis." Every such " roughness," " burr," " crack," and " fissure " in the grooves, is a sufficient obstructive to the exit of the soft metal studs, as they wedge their way over the lands out of the gun, to increase greatly the force of the " wriggle " natural to the shot.

The Omitted Document.—The omission from the Committee's Report of any examination of the injured studs and base-marks of the recovered 700-lbs. projectiles, is very remarkable, considering the great care displayed in registering the pressures yielded by each discharge. Had another column been added to the Practice Table, giving, if need be, a microscopic examination of the condition of the studs and projectiles on recovery, a comparison between the pressures and the resistances experienced by the escaping shot would have been most valuable. The omission is very remarkable, seeing Colonel Campbell's evidence against the studs and the rifling generally, before the 35-ton Gun Competitive Council; and what very opposite testimony was borne by Sir William Armstrong on the same occasion, as to the transcendental virtues of studs, and of that

increasing spiral which necessitates their use.* "With regard to the "studs," said Sir William, "I would point out that, in future, where "much milder powder will be used, the strain upon the studs will be "proportionately less, *because of course it is the maximum pressure which "causes the failure of the stud.*" If, then, the defender of the stud-system himself stated of this very gun that "*the maximum pressure "causes the failure of the stud,*" why was not the extent of this "failure" noted?

Moreover, the Special Committee, in recommending, last February, a method of proving heavy guns with projectiles of double weight, evince their anxiety about the stability of the studs, and their influence on the endurance of guns, by suggesting that the proof should consist of "one round of battering charge of pebble powder and projectile of "service weight, two rounds of battering charge of pebble powder and "*unstudded* projectile twice the weight of the service projectile;" and even for the lighter M.L.R. guns, the Committee recommend the suggested proof projectile to be "*unstudded,*" and the Superintendent of the Royal Gun Factories consistently agrees that, if such a mode of proving guns be adopted, "in such case *the cylinder should not be "studded.*"† Thus, it is evident that the Special Committee and the able Superintendent of the Royal Gun Factories are of one mind with regard to the effect of high pressures on the stud, and through the stud upon the gun, concurring, apparently, with Sir William Armstrong, that "*the maximum pressure causes the failure of the stud.*"

Again, in all other heavy guns rifled on this most unmechanical system, the projectiles are so injured in their efforts to wriggle their way out of their bores that they are obliged, when picked up, to be re-melted; excepting, in the case of "proof" projectiles, which have, however, to be re-studded. Seeing that the rifle-bearing in each groove is precisely the same for 115-lbs. and for 700-lbs. shot, might not a similar, not to say an enhanced, destructive action be reasonably supposed to occur in the case of 700-lbs. shot?

Surely, then, the extent of "the failure of the stud," as to its shearing and wedging, as to its non-centering, and as to its keeping the iron part of the projectile from touching the bore, ought to have been carefully recorded before running off into such phrases as "wave "pressures" and "local action," which mystify the unlearned and explain nothing. Let us exhaust scientific research into the tangible, and visible, and into every possible mechanical disturbing element, before giving the rein to fertile imaginations, and seeking refuge in inscrutable phenomena. Of course there are gas waves in the gun, but what makes these "wave pressures" to vary in intensity? When the waves of the sea overwhelm a ship, practical seamen ask not what was wrong in the waves? but what was the fault of the ship? And when "intense wave pressures" act unexpectedly upon a shot, practical gunners inquire what was wrong with the projectile?

"*The Oblique Movement.*"—In the absence of examinations of the

* See Parliamentary paper No. 308 of 1870, being the "Report of the Ordnance Council on the Proposed 35-ton Gun Competition," page 13.

† See "Extracts of Artillery Proceedings," &c., vol. x, Part II, pages 85, 86.

recovered 700-lbs. shot, they may be supposed to have had similar marks to those observed on all other recovered projectiles, which have, in consequence, to be destroyed or re-studded. Those marks generally coincide with that mechanical action of the studs, which gives rise to what the Professor of Artillery calls an "oblique movement of "the axis of the projectile."

The official work on *Ammunition*, Part II, page 57, points out that "in all Woolwich guns, both the direction and twist are given by the "bearing of the studs on the grooves, the *body of the shot never being "intended to come into contact with the bore;*" and, page 58, "it may be "observed that by the time the projectile reaches the muzzle of the "gun, considerable wear has taken place on the driving edges of the "studs," on the exactly *rounded* character of which all centering depends. Yet Colonel Owen rightly states that "in order to secure "accuracy of fire, *it is essential that the axis of the projectile should "correspond with that of the bore.*"

The studs are necessarily attached to the shot at a fixed angle; but the grooves they traverse are cut at ever-changing angles. The studs being fixed, cannot, therefore, touch the changing sides of the grooves at more than one angle, *i.e.*, at one point. The point selected for both studs to share the effort of rotation is twelve inches from the muzzle. In all other parts of the bore, this constantly changing angle in the spiral, necessitates the concentration of rotatory effort upon the rear-studs; that is to say, the length of bearing in each groove is the same, whether the weight of the shot to be rotated, be 115 lbs. or 700 lbs., or, as in guns designed, 1,200 lbs. The work to be done is vastly increased in the heavier shot, but the bearing in each groove is the same. As the studs won't stand the additional work, they shear or wear down their radial bearings, on which all centering action depends. Thus a most essential condition of all rifling is destroyed.

In its seat, the shot rests on the two studs in the lower groove, the other studs being only partially inserted into their grooves, the centre or axis of the shot is below the centre or axis of the gun, the whole of the windage is in the upper part of the bore, and no part of the projectile is in contact with the barrel except the two lower studs. These studs being nearly under the centre of gravity, the shot is balanced in unstable equilibrium, the "loading" edge of the lower studs touching the "loading" side of their grooves. All the roughnesses or scoring, which are caused by the escaping gases, are found above the seat of the projectile, and seldom occur in any gun, below its base, which is usually embedded in fouling matter. Hence, the concussion of the first part of the explosion takes effect upon and above the base. The blow from the gases in the initial stages of combustion as they escape above the shot, strikes the base down and the point up, hitting the upper groove a blow with the front stud, and setting up a vertical motion of an "oblique" character. Doubtless, the fouling matter in the gun may sometimes raise the base of the shot in its seat, admitting the gases below as well as above the projectile. Thus enveloped before starting, the resolution of forces would cause the initial movement of the shot to be upwards at the base, and down at

the point. Probably this occurs when the *centre* of a "down" groove is found cracked or fissured in the seat. But the marks and roughnesses generally found in "Woolwich" guns point to the first gases evolved from the ignition of the upper side of the cartridge, passing out above the seat, before the shot starts. It is clear that the vertical motion is the first movement initiated in the seat, and is begun during the initial stages of combustion.

If the shot were pushed gently forward for eight inches, the lower rear-stud would then touch on the "driving" side, and the other rear-studs, not being so deep in their grooves as the lower ones, would come *successively* into bearing against the "driving" edges. As the lateral bearing is at best only a ring of one-inch points, in rear of the centre of the shot, a tendency to turn upon those points sets up a horizontal motion of an "oblique" character. Any obstacle from roughnesses, enlargements, burrs, dents, fissures or cracks, which increases the friction on the rear-studs, enhances the force of the "oblique movements" about the studs. Thus, "oblique movements of the axis of "the projectile" in two directions, are provided for in the mechanical action of the rear studs.

This mechanical action was thus described at the Civil Engineers' Institution, last year, by Mr. C. W. Lancaster:—"The 700-lbs. shot of "the Woolwich 35-ton gun, before being fired, rested on the bottom of "the bore, and had not only to be rotated by the action of the studs, "but to be lifted as well, and then projected through the bore at the "rate of between 1,300 and 1,400 feet per second, thus involving a "double duty. When the shot rose, the bronze studs struck against "the angles of the grooves. * * * * In fact, so violent was the "action, that not only were there numerous instances of sheared studs, "but the impress of the grooves in the gun was left upon the body of "the shell, to the depth of nearly one-tenth of an inch. That, he contended, was not fair play, either to the constructors of the gun, or to "the country which had to pay for it."

Mr. Bashley Britten had pointed out that "The irregular action "upon the studs was practically shown by the unequal wear they "frequently sustained. When all went well, the studs of recovered "shot were only moderately compressed and burnished; at other times "the compression was considerably greater; and frequently, even when "there had been no increase of charge, the studs were found to have "been jammed and ground away to one-tenth of an inch or more, "affording unmistakable evidence of the violence with which they had "been pressed against the bore, and of the force of the charge thus "thrown upon the gun."

The front studs are intended to come into "driving"-bearing 12 inches from the muzzle, when the shot is moving with a striking force of about 6,000 foot-tons. When they fulfil this evil intention, a second set of mechanical forces come into operation. But, as there is no evidence that the front studs performed their office in the 35-ton gun, it is unnecessary here to investigate their mechanical action.

Mechanical Causes of High Pressures.—If, when in its seat, the projectile be not gently pushed, but violently struck upon and above its

base, it is evident that the important element of time will be greatly diminished, and that the obstruction resulting from these "oblique "movements of the axis" about the rear-studs, will increase in severity with the suddenness and violence of the blow. Thus, the mechanical obstruction offered to the free escape of the shot, would be more marked, and the accumulation of gases behind it be much greater:—

1. When more quick-burning, and therefore more sudden or violent powder is used, giving the wriggling shot *less time* to recover its direction.

2. When heavier powder charges are employed, also giving the wriggling shot less time to recover its direction.

3. When the temperature of the powder chamber has been highly raised by previous discharges, causing more sudden and complete combustion.

4. When the gun is so elevated that the influence of gravitation acts with greater power against the shot's escape.

5. When short shot are used in the same bore, the "oblique move-"ments of the axis" round the studs causing an accumulation of gases, are obviously much more forcible, *e.g.*, a 600-lbs. shot gives higher pressures than a 700-lbs. shot in a 12-inch bore.

6. When a hard roughened surface, with steel furrows as deep as those on the bark of an elm tree, occurs in the path of the brass stud, so that the gun-metal may catch in the furrows, and the "oblique move-"ment of the axis of the projectile" around the rear-stud be intensified, then the escape of the shot would be more difficult, and an accumulation of gases would take place in its rear (see Plate I).

These mechanical movements are naturally erratic, the "wriggling" being more or less severe, according to various conditions of an accidental character. Of course the more severe wriggles cause the highest pressures, and mark the bore most severely at the point of obstruction. Hence, a careful study of the marks within the gun and upon the projectile, is essential to any reliable deductions from tabulated powder-pressures.

The "Milder Powders" used.—Only two kinds of, what Sir William Armstrong calls, "milder powder," were used in the 35-ton gun, viz., Waltham Abbey P. and Belgian P. P. stands for "pebble" and "pellet" powders indifferently, both being similar in character; but a military critic says that the kind of P. used with the 35-ton gun was "pebble-powder."

The manufacture of gunpowder has reached such perfection that its explosive force can be perfectly controlled with exactitude and uniformity, being varied at will to ignite rapidly or slowly, and to burn slowly or quickly. Slow burning is, of course, characteristic of the slow action "milder powder" used in the 35-ton gun. Quick-burning distinguishes the violent "brutale" powder formerly in use. This change is managed by altering the granulation and density of the same thoroughly incorporated ingredients. In the P. powder, the mass of ingredients is divided into large irregular pebbles, shapely pellets, or split pellets, through the wide interstices of which the flame rushes freely, igniting all the pebbles rapidly; but, once ignited, the large

pebble takes time to consume, slowly burning from the outside to its centre. If the pebble be porous, the flame will penetrate to its centre more rapidly than if it be more closely pressed, *i.e.*, more dense.

On the other hand, where the mass of thoroughly incorporated ingredients is divided into smaller grains, these lie closer together in the cartridge, and the flame cannot get between the grains from the point of ignition to the extremities of the charge so rapidly as when there are wide interstices. When, however, the flame does touch the outside of the smaller grain, its centre is soon reached, making combustion very rapid. The R.L.G. belongs to this type of quick-burning, violent powder, and was not, therefore, used in the 35-ton gun.

The Belgian P. was more violent in its action than our W.A.P. This arose, I suppose, either from the ingredients being mixed in different proportions, or from the pebbles being more porous, and thus consuming more rapidly.

Diminution of violence is not the only result of enlarging the grains. The gases evolved from the combustion of slow-burning pebbles operate more gradually and for a longer period upon the shot, only attaining their maximum force, in the case of the 8-inch gun, when the projectile has moved 6 inches; whilst the quick burning R.L.G. powder attains double the force before the studded shot moves one quarter of an inch. But, though only half the pressure is evolved by the slow-burning P., it sticks to its work longer, and results in slightly greater velocity to the shot. Moreover, this more gradual application of force to the projectile, with half-pressure in the gun, enables larger charges to be safely employed, with increased velocity and striking force.

The able Superintendent of the Royal Gun Factories, however, remarks "that the very heavy charges of pebble powder, although they may "not give the same pressures as the former charges of R.L.G., still "really do much more real damage to the guns, and will render the "necessity of re-venting, and, indeed, of re-tubing the guns, much "more frequent."*

Register of Pressures in Guns.—The mode of determining the explosive force of gunpowder within guns, by means of crusher-guages and chronograph, has already been described at this Institution in a most valuable paper, by Captain J. P. Morgan, R.A., the able Assistant Superintendent of the Royal Gunpowder Manufactory.† That paper, published in our Journal, I would cordially commend to everyone who wishes to understand what has been done in the past to determine powder-pressures; how little is at present understood on the subject; what an ocean of knowledge remains unexplored; and how invaluable such knowledge, when acquired, is likely to prove both to the manufacturer and to the artillerist. He will also find in Captain Morgan's paper some indications of the futility of trying to create laws for nature, and the advisability of scientific men confining themselves rather to ascertaining and interpreting the ex-

* "Extracts of Artillery Proceedings," &c., vol. x, Part II, page 101.

† "Journal of the Royal United Service Institution," vol. xv, No. 64, page 312 et seq.

isting and unalterable laws of nature. For example, when Robins, the father of scientific gunnery, estimates the maximum pressure evolved from ignited gunpowder at 6·7 tons per square inch; Gay-Lussac at 14·3 tons; Piobert at 64 tons; Bunsen and Schischkoff at 30 tons; Professor Bloxam at 62 tons; and Captain Noble of Elswick at 40 tons, may we not ask those who rest satisfied with such phrases as "wave pressures," "local action," &c., to examine more closely into the disturbing causes which produce the phenomena disguised under the above phraseology?

Practice with 11·6 inch 700-lbs. Shot (Table I, pp. 16 and 17).

Let us consider the mechanical forces at work to influence the powder pressures registered in the 11·6-inch bore. The Practice Table shows that the registering arrangements were not so complete for the 35 rounds with this calibre, as for the 38 discharges from the 12-inch barrel. In 23 rounds, the pressure at the bottom of the bore, where it is usually highest, was not taken; in three rounds, no pressures at all were registered; on four occasions, the cartridge was ignited at the rear-end and twice at the front, the remaining 29 charges being ignited at the usual service position, viz., 12 inches from the bottom; and in three instances, the less slow-burning, and therefore less mild, Belgian P. powder was employed. Eliminating such disturbing elements, we may still find a good many charges fired under precisely similar conditions, which, had the mechanical obstructions to the escape of the projectile been exactly alike, ought to have produced similar results.

As compared with the practice from the 12-inch barrel, the maximum pressures registered in the smooth unroughened 11·6-inch bore, were, as we should expect, more eccentric, and, therefore, higher in proportion to the resulting velocities and striking force. Obviously, for the gases to expand to equal bulks, it is necessary that the shot should move further from its seat in the 11·6-inch bore than in the 12-inch barrel. But the resistance offered by the lower studs on which the shot rest, is intensified by the extra rapidity and suddenness of the force applied to them. Hence the shot, being of the same weight, and of nearly the same length, we should expect, with the same P. charges, a more powerful, and therefore, more obstructive, "oblique movement "of the axis of the projectile" about the rear-studs in the smaller bore, causing a more perfect combustion of powder and a greater accumulation of gases.

Rear-ignition in 11·6-inch Bore.—Comparing the two 75-lbs. P. charges ignited at the vent (Nos. 1·2) with the two (Nos. 9·10) ignited at the rear, the former appears to have resulted in the best powder combustion; but the resulting energy was a thousand foot-tons *less* than that evolved from a somewhat less base-pressure in the 11·6-inch bore (No. 31), and in the 12-inch barrel (No. 1·3·5·9·11). A vent-ignited 75-lbs. P. charge behind a shorter 600-lbs. shot, gave less expulsive pressure (16·6 tons) with 72 feet more velocity; and, according to the anomalous performances of studded shot, we should expect

less pressure behind the heavier 700-lbs. shot. Instead of following this "rule of contrary," No. 2 gives a higher pressure than with the lighter shot, showing that something unusual occurred, and inclining us to believe that, but for this irregularity, it ought to have been less than Nos. 9·10, *i.e.*, less than 14 tons per square inch.

This idea is confirmed by a comparison of the two 110-lbs. P. charges ignited at the rear (Nos. 18 and 19), with Nos. 11 and 13 ignited at the vent, when the opposite effects resulted. The pressure on the projectile was nearly 2½ times *greater* when ignited at the rear (and not less as with the 75-lbs. charges); but no adequate increase of striking force resulted from this 2½ times extra expulsive pressure, showing that this extra explosive powder did not arise solely from the point of ignition, but that extra impediments to escape were experienced by the 18th and 19th projectiles.

Front-ignition in 11·6-*inch Bore.*—Front-ignition would appear to have caused a more perfect combustion of 110-lbs. charges than ignition at the vent. But it is simply absurd to suppose that front-ignition accounts for 13 tons per square inch extra expulsive pressure in No. 14, when the striking force developed was very slightly increased; and the five extra tons pressure per square inch upon the 12th projectile, was evidently caused by the absorption of *seven hundred foot-tons* of energy within the gun as compared with Nos. 11·13.

It may be questioned by some whether this extra expulsive pressure was the cause or the effect of obstructive movements in the projectile, as changing the points of ignition did undoubtedly alter, in some degree, the relative conditions. Therefore, the effects of the "oblique "movements of the axis of the projectile" about its studs could not be exactly predicated from these comparisons alone.

Belgian P. Charges in the 11·6-*inch Bore.*—The pressures and velocities registered from the three Belgian P. charges may be compared together, but cannot be compared with those of W.A.P., as it is well known that the more quick-burning powder operates for a shorter time upon the shot, and is productive, therefore, of lower velocities. It may, however, be noted that when 49·1 tons expulsive pressure were exerted against each square inch of the base of the projectile, *less* velocity and work resulted than when 46 tons pressure was registered, both charges being Belgian P. ignited under similar conditions, except that, perhaps, the chamber was warmer when the *smaller* pressure occurred.

The W.A.P. Charges in the 11·6-*inch Bore.*—Eliminating all exceptional conditions, it is evident that the velocity and striking force of projectiles fired under identical circumstances ought, when the same kind of powder is used, to bear a constant relation to the pressures exerted upon their bases. Where this relation is inconstant, the lowest expulsive pressure which gives the highest velocity, may be fairly taken as the nearer approach to the normal results to be expected from that charge with that kind of shot, as also the case of least "wriggling" obstruction to the exit of a studded projectile.

The 31st round would, at first sight, appear to be the normal 110-lbs. W.A.P. charge, as it gives the highest velocity with

TABLE I.—PRACTICE WITH THE 11·6-INCH, 35-TON M.L.R. GUN.

STUDDED shot, 700 lbs. The pressures were determined by crushers fitted by means of a copper cup at the bottom of the bore (A), by a screw gauge inserted instead of the vent-plug (B), and by a gauge screwed into the base of the projectile (C). After the 8th round, the gun was fired by an electric tube placed in the cartridge at 12 inches from the bottom, the wires passing through a groove in the shot to the muzzle.

Date of the discharge.	No. of the round.	Powder charge. Brand.	Powder charge. Weight.	Observed velocity at 110 feet.	Observed velocity at 132 feet.	Maximum pressure by crusher-gauge in tons per square inch. A. Axis, or end of bore.	B. Vent, or 12 in. from end of bore.	C. Base of shot when about 33½ in. from end of bore.	Striking force at 110 feet in foot-tons.	Point of ignition of cartridge.	State of the bore. (*Powder chamber uninjured.*)
			lbs.	feet.	feet.						
Jan. 13, 1871 ..	1	W.A.P., May 9, 1870	75	1,163	not taken	not taken	not taken	not taken	6,567	Service	Before the Experiment:— Bore clear and polished. After 6th round:— Driving edges of the grooves slightly worn, specially in L. of Up., 40½ to 63 in. from A. Slight roughness by gas, 27½ to 49½ in. from A.
,,	2	,, ,, ...	,,	1,163	,,	,,	,,	17·1	6,567	,,	
Jan. 14, 1871 ..	3	,, ,, ...	100	1,261	,,	,,	,,	not taken	7,718	,,	
,,	4	,, ,, ...	,,	1,237	,,	,,	,,	25·4	7,435	,,	
Jan. 16, 1871 ..	5	,, ,, ...	120	1,350	,,	,,	,,	not taken	8,852	,,	
,,	6	,, ,, ...	,,	1,364	,,	,,	,,	46·3	9,026	,,	
Jan. 18, 1871 ..	7	,, ,, ...	110	1,303	,,	,,	,,	31·8	8,242	,,	After 8th round:— Maximum enlargement, ·007 in. at 13½ in. from A.
,,	8	,, ,, ...	130	1,348	,,	,,	,,	63·7	8,816	,,	
Feb. 2, 1871 ..	9	W.A.P., Dec. 21, 1870	75	1,091	,,	,,	15·2	13·9	5,781	Rear	
,,	10	,, ,, ...	,,	1,090	,,	,,	16·4	13·1	5,772	,,	
	11	,, ,, ...	110	1,240	,,	,,	19·8	20·8	7,464	Service	

,,	12	,, ,, ...	,,	1,183	,,	,,	26·6	25·7	6,792	Front	
,,	**13**	,, ,, ...	,,	**1,244**	,,	,,	**18·8**	**19·2**	**7,508**	**Service**	
Feb. 3, 1871 ..	14	,, ,, ...	,,	1,245	,,	,,	31·8	33·8	7,521	Front	
,,	15	,, ,, ...	120	1,277	,,	,,	16·4	20·7	7,911	Service	
,,	16	,, ,, ...	,,	1,251	,,	,,	18·8	26·3	7,599	,,	
,,	17	W.A.P., May 16, 1870	,,	1,300	,,	,,	28·6	40·4	8,206	,,	
,,	18	W.A.P., Dec. 21, 1870	110	1,277	,,	,,	34·3	47·9	7,911	Rear	
,,	19	,, ,, ...	,,	1,274	,,	,,	38·6	48·3	7,880	,,	
,,	**20**	W.A.P., { May 16, 1870, 41 lbs. / July 29, 1870, 79 lbs. }	**120**	**1,353**	,,	,,	**20·0**	**21·7**	**8,883**	**Service**	After 20th round:— Roughness by gas increased in depth 25½ to 61½ in. from A. Greatest depth in L. of Up. Maximum enlargement, ·024 in. at 34½ to 40½ in. from A.
April 19, 1871 .	21	W.A.P., Oct. 18, 1870..........	110	1,077	,,	27·6	20·3	26·0	5,637	,,	
,,	*22*	*Belgian P., March* 1871........	,,	*1,288*	,,	*31·0*	*31·0*	*49·1*	*8,047*	,,	
,,	23	W.A.P., Oct. 18, 1870..........	,,	1,151	,,	not taken	20·2	24·5	6,433	,,	
,,	*24*	*Belgian P., March* 1871........	*	*1,328*	,,	,,	*44·2*	jammed†	*8,557*	,,	
,,	25	W.A.P., Oct. 18, 1870	,,	1,157	,,	,,	20·8	23·5	6,494	,,	
,,	*26*	*Belgian P., March* 1871........	,,	*1,297*	,,	*37·6*	*29·8*	*46·0*	*8,165*	,,	
April 20, 1871 .	27	W.A.P., Oct. 18, 1870	115	1,279	,,	24·4	21·6	25·2	7,934	,,	
,,	28	,, ,, ...	,,	1,271	,,	25·2	23·4	30·2	7,839	,,	
,,	**29**	,, ,, ...	,,	**1,271**	,,	**23·2**	**19·8**	**23·4**	**7,839**	,,	After 29th round:— The principal enlargement is, from ·015 in. at 28½ in. from A to ·029 in. at 43½ in. from A. Maximum enlargement, ·033 in. at 37½ in. from A., *i.e.*, about four inches outside the max. pow. press. area.
May, 9, 1871 ..	30	,, ,, ...	110	1,249	1,243	24·2	19·6	20·6	7,573	,,	N.B.—No examination took place after the 35th round, and before boring out all the roughnesses of gas, burrs on the edges of the grooves, &c., in converting the 11·6 in bore into a 12-inch gun.
,,	31	,, ,, ...	,,	1,248	1,251	24·8	21·6	16·8	7,560	,,	
,,	32	,, ,, ...	,,	1,236	1,244	26·0	21·8	22·2	7,420	,,	
,,	33	,, ,, ...	115	1,226	1,277	28·6	22·2	30·8	7,295	,,	
,,	34	,, ,, ...	,,	1,222	1,273	26·8	22·4	30·2	7,246	,,	
,,	35	,, ,, ...	,,	1,148	1,273	32·8	26·8	31·8	6,393	,,	

* Charge doubtful. † Pressure must have exceeded 60 tons.

the lowest expulsive pressure, but I am inclined to doubt the accuracy of the registered pressure on the base, as it is so much less than that which occurred at the vent. Therefore, the 13th round would appear to be the normal 110-lbs. W.A.P. charge, giving, with 19·2 tons base-pressure on the square inch, a resulting blow of 7,508 foot-tons at 110 feet from the muzzle. These normal results appear to correspond very fairly with Nos. 11, 30, and 32. But contrast the normal 110-lbs. W.A.P. charge, No. 13, with No. 4, where six extra tons expulsive pressure per square inch, with 100 lbs. of powder, gave a less blow; with No. 21, in which 1,829 foot-tons of work were absorbed by the escaping projectile, causing the crusher-gauge to go up seven extra tons; with No. 23 and 25, where the escaping projectiles absorbed in the "oblique movement of their axes" about the rear-studs, upwards of a thousand foot-tons of work, causing the gases to register 5 and 4 tons extra pressure; and with No. 7, where 12 extra tons per square inch on the base only produce about 700 foot-tons greater blow. What must have been the wriggling and stud-wedging in the gun and the condition of the studs which absorbed all this useful work?

It will be observed that Nos. 21, 23 and 25 were of the same brand, yet No. 21 projectile absorbed in its "oblique movements" within the gun 857 foot-tons of work more than that absorbed by No. 25, causing the gases to accumulate to $2\frac{1}{2}$ tons greater expulsive pressure against its base.

Again, No. 29 approached nearest to the normal of the 115-lbs. charges, for its projectile would have struck a 7,839 foot-ton blow, as the result of 23·4 tons pressure per square inch upon its base. A blow of identical force was produced by nearly seven tons more base-pressure on the square inch, in No. 28. Whilst a comparison of the last round (No. 35)* with the normal 115-lbs. charge (No. 29) shows the projectile absorbing 1,446 foot-tons of work, causing the highest accumulation of gases registered with any similar charge. Indeed, comparing the first three 115-lbs. charges with the last three, I am inclined to think some roughening of the grooves must have taken place in advance of the seat of the studs subsequent to the last examination. The means of these 115-lbs. charges show clearly that the diminution of striking force produced an accumulation of gases in the gun. They are:—

115-lbs. W.A.P. 11·6-inch charges.	Mean velocity.	Mean pressure at			Mean striking force.
		Axis.	Vent.	Shot.	
	feet.	tons.	tons.	tons.	foot-tons.
Nos. 27, 28, 29 .... =	1,274	24·3	21·6	26·3	7,871
Nos. 33, 34, 35 .... =	1,199	29·4	23·8	30·9	6,978

* This No. 35 may possibly be a typographical error. But the Report throws little or no light upon the table, and the figures can only be accepted as given.

The normal 120-lbs. charge is the 20th, the "oblique movement of "the axis of the projectile" about the rear-studs, being evidently *less* severe than in the case of the succeeding 115-lbs. charges, and only little more so than with the normal 110-lbs. charge (No. 13). Probably No. 20 is an accidental instance in which the shot escaped with a very slight "oblique movement," and its studs without any shear or wedging, and perhaps it may have nearly centered itself in the bore. Such a phenomenon would explain the fact that the shot escaped with 8,883 foot-tons of striking force in it, having sustained a base-pressure of only 21·7 tons. If the axis of every escaping projectile had corresponded with the axis of the piece, then every accretion of powder gases in the rear would have produced an increased striking force. But, on the contrary, with only one exception in which more than double pressures occurred (No. 6), every weaker blow with 120-lbs. charges (except No. 15)* was attended with higher accumulations of gases. Thus, as compared with the normal 120-lbs. charge, the 17th projectile absorbed 677 foot-tons of work, causing the gases to rise to nearly double the pressure; the 6th shot, projected by 25 ton per square-inch greater pressure, attained only 143 foot-tons greater energy; whilst 130 lbs. of similar powder (No. 8) exerted nearly three times the pressure of the normal 120-lbs. charge upon its projectile, yet resulted in 67 foot-tons *less work*. Now, Sir Wm. Armstrong says, "*of course, it is the maximum pressure* "*which causes the failure of the stud*," and the late Ordnance Select Committee reported that "*the gun rifled on the French* ('*Woolwich*') "*system has decidedly the lowest velocities.*" May we not reasonably ask when this maximum pressure of 63·7 tons was registered on the base with low velocity in the projectile, what was the extent of "the "failure of the stud"? and what became of the expulsive force developed by the 130 lbs. of similar powder? As the bore within the maximum powder-pressure-area was not strained, where was the power of these gases absorbed? The "local action" was on the base of the shot, where did the shot convey it to, as it was not carried out of the gun?

Sir Henry Storks "has never been satisfied with the discrepancies "as to the amount of pressure produced by a comparatively small increase in the charge of powder." The expulsive pressure per square inch given by the normal 120-lbs. charge was 21·7 tons on the base of the projectile, that given by the 130-lbs. charge was 63·7 tons. The same powder was employed under identical conditions. When 130-lbs. charges are exploded in torpedoes, in mines, or anywhere except in a French-rifled gun with short rifle-bearings, is the explosive force evolved, found to be three times that of 120-lbs. charges? It is the fault of the powder-manufacturer say some—but is it found that small charges of similar powder produce these anomalous results? And do not the

* Cases like those of No. 15, where a lower base-pressure was productive of a lower velocity, may arise from the "oblique movement" or wriggle taking place nearer the muzzle, as when the front studs come violently into bearing 12 inches from the outer end of the bore. Then the velocity would be checked, but the accumulation of gases would not, except in very severe wriggles, exceed the maximum powder pressure which had already been registered after the shot had moved 6 inches.

Committee report that "when *any description* of powder is increased "beyond a certain limit," these "discrepancies as to the amount of "pressure produced" always occur?

Perhaps, say others, the pebbles may have fallen evenly together in the cartridge, so as to fit like bricks in a wall, leaving no interstices between;—but, in that impossible case, the shot would be driven out slowly long before the flames reached the centre of the compact mass, and the crusher in its base would register a lower, not a higher pressure. It's all those "intense wave pressures," say others;—but, why do "gas waves" vary in height to three times their usual altitude? Grant that the injuries sustained by every recovered and broken-up projectile are inflicted within the gun; that there is "an oblique movement of the axis of the projectile" about the rear-studs; that "it is "the maximum-pressure which causes the failure of the stud;" and that, in short, mechanical forces are at work during the exit of the shot, checking its progress, and causing an unwonted accumulation of gases in its rear, and the greater part of the phenomena is solved.

Practice with 12-inch 700-lbs. Shot (Table II, pp. 22 and 23).

The Practice Table of the 12-inch barrel is very complete as regards both the pressures and the examinations of the bore, though, as before, we have no account of the injuries sustained by the several projectiles. The increase of calibre was, of course, attended with diminished pressures from similar charges. The bore, however, began to develop at an early stage those roughnesses, burrs on the edges of the grooves, and enlargements in front of the seat of the studs, which, by obstructing the path of the studs, intensify the "oblique movement of the axis "of the projectile" about the rear ring, thus checking its escape and causing an accumulation of gases in the powder chamber. This can be very clearly traced in Table II by comparing the earlier with the later pressures, and observing how these are generally attended with an absorption of useful work within the gun. This table is, in this respect, far more instructive than the less perfectly-recorded practice with the 11·6-inch bore.

The Belgian 12-inch P. Charges.—The seven quicker-burning Belgian P. charges naturally gave high pressures which acted for shorter periods upon their projectiles, and therefore produced relatively inferior results; but these pressures ought to have been as regular in the gun as they would have been in a shell, in a mine, or in a torpedo, unless some forces operated in the gun which find no place in the shell, in the mine, or in the torpedo. The bore presenting a polished surface when the three 110-lbs. Belgian P. charges were fired, the irregularities are very remarkable; still, we find the first one (No. 2 discharge) yielding six tons more pressure than the other two, without any adequate increase of striking force.

The four 115-lbs. Belgian P. charges acted more violently on the wriggling shot, giving them less time to recover their true direction. No. 10 shot appears to have suffered least, as it took away with it 8,936 foot-tons of useful work as the result of 26·4 tons' expulsive

pressure. But the 12th and 14th shot found or formed a slight enlargement of the bore at the point where their rear-studs come into bearing and the front-studs hammer, which would naturally intensify "the oblique movement of the axis of the projectile" about the rear-ring of studs; and, accordingly, the gases accumulated behind these shot, to the extent of 23 and 21 tons per square inch extra expulsive pressure respectively, without any noteworthy increase of velocity and striking force. There were "intense wave pressures" no doubt, but the powder and all its apparent conditions were alike, and you might as well blame the "waves of the sea" for overwhelming a badly-ballasted ship, as say that this vast absorption of expulsive force within the gun was caused by "wave pressures."

The Waltham Abbey 12-inch P. Charges.—The "milder" slow-burning W.A.P. charges evinced at least four clearly-defined effects :—

1st. The pressure on the base of the shot was, generally, several tons less than that registered at the inner end of the bore, and, in the higher ones, a little more than that at the vent.

2nd. *All the earlier discharges, when the 12-inch bore was fresh from the factory, gave very regular and low pressures, with very fairly corresponding striking forces.*

3rd. *When the bore was roughened, burred, enlarged, fissured and cracked just in front of the seat of the studs, the pressures were very high and very irregular, with an utter lack of correspondence in the resulting striking forces.*

4th. *The space within which the maximum powder pressure is confined by the projectile, is, except as to erosion over the base of the shot, wholly uninjured from the intense pressures; whilst the centres of the injuries are upwards of $3\frac{1}{2}$ feet from the point where the maximum powder pressures were registered, and correspond, as nearly as possible, with that point in the bore where the front-studs would strike, and where the rear-studs were driven into bearing, and where "the oblique movement of the "axis of the projectiles" about their rear rings of studs would necessarily be most intense.* (See Plate I.)

To make these points quite clear, Table III has been formed, in which are given, 1st, the results with each charge when the "oblique "movement of the axis of the projectile" was at a minimum, being the least objectionable or normal mechanical condition; 2nd, the mean results when the bore was fresh from the factory; and 3rd, the mean results when the bore was roughened, burred, fissured, cracked, and enlarged by the front-studs and in front of the point of driving contact of the rear-studs. (See Plate I.)

Cause and effect are brought out very clearly in Table III, establishing a *primâ facie* case against the projectile, which a more minute examination of the detailed Table II fully justifies.

TABLE II.—PRACTICE WITH THE FIRST 12-INCH 35-TON M.L.R. GUN.

STUDDED shot, 700 lbs. The pressures were determined by crushers fitted by means of a copper cup at the bottom of the bore (A), by a screw-gauge inserted instead of the vent-plug (B), and by a gauge screwed into the base of the projectile (C). The gun was fired by an electric tube placed in the cartridge at 12 inches from the bottom, the wires passing through a groove in the shot to the muzzle.

Date of the discharge.	No. of the round in all.	No. of the 12-inch discharge.	Powder Charge. Brand.	Powder Charge. Weight.	Observed velocity. At 110 feet.	Observed velocity. At 132 feet.	Maximum pressure by crusher-gauge in tons per square inch. A. Axis, or end of bore.	B. Vent, or 12 inches from end of bore.	C. Bases of shot, when about $33\frac{1}{2}$ in. from end of bore.	Striking force at 110 feet in foot-tons.	State of the 12-inch Bore. (*Powder Chamber uninjured*). See Plate I.
				lbs.	Feet.	Feet.					
Oct. 19, 1871.	36	1	W.A.P., Oct. 18, 1870........	110	1,274	1,266	20·2	20·0	17·2	7,880	Before the Experiment:— Bore clear and polished.
”	*37*	*2*	*Belgian P., March*, 1871......	”	*miss*	*1,301*	*28·4*	*23·6*	*30·5*	*8,220*	
”	38	3	W.A.P., Oct. 18, 1870	”	1,265	1,269	20·0	19·2	16·8	7,768	
”	*39*	*4*	*Belgian P., March*, 1871......	”	*1,299*	*1,302*	*23·6*	*21·8*	*24·2*	*8,191*	After 12th Discharge:— Maximum enlargement ·009 in., $43\frac{1}{2}$ to $46\frac{1}{2}$ inches from A, *i.e.*, 10 inches outside the area of maximum powder pressures, and exactly where rear-studs come into "driving" bearing, and where front studs hammer.
”	40	5	W.A.P., Oct. 18, 1870	”	miss	1,272	20·2	19·8	17·6	7,852	
”	*41*	*6*	*Belgian P., March*, 1871......	”	*1,296*	*1,306*	*24·8*	*21·2*	*24·4*	*8,154*	
”	42	7	W.A.P., Oct. 18, 1870........	115	miss	1,289	23·2	19·6	19·8	8,060	
”	*43*	*8*	*Belgian P., March*, 1871......	”	*1,316*	*1,323*	*30·4*	*23·2*	*29·0*	*8,408*	
Oct. 20, 1871.	44	9	W.A.P., Oct. 18, 1870	”	1,291	1,292	22·0	19·8	15·8	8,090	
”	*45*	*10*	*Belgian P., March*, 1871......	”	*miss*	*1,357*	*28·0*	*23·2*	*26·4*	*8,936*	
”	46	11	W.A.P., Oct. 18, 1871........	”	1,230*	1,242*	23·2	20·0	17·4	7,344*	
”	*47*	*12*	*Belgian P., March*, 1871......	”	*miss*	*1,360*	*48·0*	*34·6*	*49·6*	*8,973*	
Oct. 24, 1871.	48	13	W.A.P., Oct. 18, 1870........	”	1,285	miss	21·7	20·4	20·8	8,015	After 33rd Discharge:— Longitudinal crack *in edge of groove*, R. of D., 38 to 52 in. from A. Longitudinal crack *in edge of groove*, R. of Up., 46 to 52 in. from A. Longitudinal crack in centre of groove, L. of D., $45\frac{3}{4}$ to $47\frac{3}{4}$ in. from A. Longitudinal crack in centre of
”	*49*	*14*	*Belgian P., March*, 1871......	”	*1,358*	*miss*	*43·8*	*32·9*	*47·2*	*8,949*	
”	50	15	W.A.P., Oct. 18, 1870........	120	miss	1,312	20·0	18·4	18·0	8,352	
”	51	16	” ”	”	1,311	miss	27·6	20·8	23·4	8,341	

„	52	17	„ „	„	miss	1,305	25 ·6	21 ·2	23 ·4	8,264	groove, L. of Up., 43 to 45½ in. from A. Maximum enlargement, ·022 in., 40½ to 43½ in. from A. Roughness in lands and grooves by gas, 28½ to 65 in. from A. Up. Burrs on the edges of the grooves. N.B.—All these injuries (except the roughness by gas) are outside the max.pow. press.area and about where the rear-studs come into "driving" bearing, and where front studs hammer.
Nov. 23, 1871.	53	18	W.A.P., Nov. 11, 1870	115	1,283	1,286	28 ·0	20 ·8	29 ·2	7,991	
„	54	19	„ „	120	1,322	1,324	20 ·8	21 ·6	25 ·4	8,488	
„	55	20	„ „	„	1,312	1,317	32 ·4	25 ·8	31 ·6	8,352	
„	56	21	„ „	„	1,337	1,341	40 ·6	31 ·6	41 ·8	8,674	
Nov. 24, 1871.	57	22	W.A.P., Nov. 7, 1870	„	1,341	1,343	28 ·8	22 ·6	29 ·0	8,733	
„	58	23	„ „	„	1,314	1,312	28 ·8	23 ·2	31 ·0	8,382	
„	59	24	W.A.P., Nov. 9, 1870	„	1,352	1,349	38 ·8	29 ·8	39 ·0	8,876	
„	60	25	W.A.P., Nov. 7, 1870	„	1,332	1,334	38 ·4	28 ·6	37 ·4	8,615	
Dec. 1, 1871.	61	26	W.A.P., Oct. 7, 1870, No. 64	„	1,364	1,366	46 ·8	35 ·2	45 ·4	9,026	
„	62	27	„ „	„	1,360	1,358	66 ·0	42 ·6	53 ·2	8,973	
„	63	28	W.A.P., June 24, 1871, No. 11	„	1,336	1,334	44 ·6	34 ·2	46 ·8	8,662	
„	64	29	„ „ „	„	1,334	1,328	37 ·6	27 ·0	39 ·6	8,639	
„	65	30	W.A.P., No. 64	115	1,319	1,319	43 ·0	30 ·8	43 ·2	8,442	
„	66	31	„ „	„	1,306	1,305	48 ·4	28 ·8	43 ·2	8,276	
„	67	32	W.A.P., No. 11	„	1,323	1,318	44 ·0	30 ·6	41 ·6	8,500	
„	68	33	„ „	„	miss	1,318	42 ·6	28 ·4	41 ·8	8,431	
Jan. 25, 1872.	69	34	W.A.P., No. 64	110	1,291	1,293	33 ·0	17 ·8	27 ·1	8,090	After 38th Discharge:— Longitudinal crack *in edge of groove*, R. of D., 36½ to 52 in. from A. Longitudinal crack *in edge of groove*, R. of Up., 45¼ to 52 in. from A. Longitudinal crack in centre of groove, L. of D., 45½ to 48½ in. from A. Longitudinal crack in centre of groove, L. of Up., 42¼ to 47¾ in. from A. Slight fissures in centre of groove, Up., 41¾ to 43 in. from A. Slight fissures in centre of groove, L. of Up., 40 to 41¾ in. from A. Slight fissures in centre of groove, Up., 47½ to 49½ in. from A. Slight fissures in centre of groove, Up., 43 to 45½ in. from A. Maximum enlargement, ·029 in., 40½ to 43½ in. from A. Roughness in lands and grooves, by gas, 28½ to 65 in. from A. Up. Burrs on edges of grooves. N.B.—The rear-studs come into "driving" bearing, and the front stud hammers about 43 in. from A, near where the greatest enlargement and all the cracks and fissures occur. The max. pow. press. area extends to about 34 inches from A, and is wholly uninjured, except for a few inches, by gas roughening.
Jan. 26, 1872.	70	35	W.A.P., No. 11	„	1,310	1,314	27 ·8	20 ·8	27 ·2	8,330	
Jan. 29, 1872.	71	36	„ „	„	1,287	miss	26 ·6	19 ·8	24 ·4	8,037	
Jan. 30, 1872.	72	37	W.A.P., No. 64	„	1,303	1,315	32 ·8	20 ·8	28 ·0	8,242	
Jan. 31, 1872.	73	38	„ „	„	1,293	1,298	36 ·4	25 ·8	33 ·0	8,118	

* Doubtful.

TABLE III.—COMPARISON BETWEEN DISCHARGES FROM THE NEW AND FROM THE ROUGH 12-INCH BORE.

Number of 12-inch discharge, 700-lbs. studded shot.	W.A.P. charge.	Mean maximum pressure per square inch.			Mean observed velocity at 110 feet.	Mean striking force.	State of the 12-inch bore. (*Powder chamber uninjured.*) See Plate I.
		A. Inner end of bore.	B. Vent, 12 inches from end of bore.	C. Base of shot when about 33½ inches from end of bore.			
	lbs.	tons.	tons.	tons.	feet.	foot-tons.	
Normal, No. 1	**110**	**20·2**	**20·0**	**17·2**	**1,274**	**7,880**	Clear and polished.
1, 3, 5	"	20·1	19·7	17·2	1,272	7,853	
34, 35, 36, 37, 38	"	31·3	21·0	27·9	1,297	8,165	Grooves roughened, burred, fissured, cracked, and enlarged in front of the seat of the studs.
Normal, No. 9	**115**	**22·0**	**19·8**	**15·8**	**1,291**	**8,090**	Very slight enlargement in front of the seat of the studs.
7, 9, 11, 13	"	22·5	19·95	18·5	1,274	7,880	
30, 31, 32, 33	"	44·5	29·7	42·45	1,314	8,382	Grooves roughened, burred, cracked, and enlarged in front of the seat of the studs.
Normal, No. 15	**120**	**20·0**	**18·4**	**18·0**	**1,312**	**8,352**	Slight enlargement in front of the seat of the studs.
15, 16, 17	"	24·0	20·1	21·6	1,309	8,319	
26, 27, 28, 29	"	48·7	34·7	46·2	1,349	8,832	Grooves roughened, burred, cracked (?), and enlarged in front of the seat of the studs.

The first three 110-lbs. W.A.P. discharges (Nos. 1, 3, 5) were so regular in their action, that the projectiles would appear to have slid over the polished surface of the bore with uniformity of movement; whilst the last four 110-lbs. discharges (Nos. 34, 35, 36, 37, 38) had no relation whatever to the first three, or to each other. No. 1 drove the projectile out by 17·2 tons expulsive pressure on the square inch, No. 38 did so with nearly double that pressure, and yet the resulting blow would only have been 238 extra foot-tons. There was thus, evidently, an impediment to the shot's escape somewhere; and such impediment caused the gases to accumulate in its rear to nearly double their wont. An impediment is found in the bore at the point of "driving" contact of the rear-studs sufficient to set up an intense "oblique movement of "the axis of the projectile" round the studs. (See Plate I.)

Now, 110 lbs. W.A.P. powder is the maximum service charge to which this gun is reduced. *If* 38 *horizontal discharges, spread over one hundred and four days, upwards of* 24 *hours elapsing between each of the last four rounds, doubles the pressures,—what might occur if, at the end of three years' training practice at sea, firing eight rounds every three months, or* 96 *discharges in all, the ship had to go into a naval bombardment—in which time is an important element—and fired with elevation at the rate of* 20 *rounds per hour for a few hours?*

The lowest pressure registered on the base of the 12-inch shot was 15·8 tons per square inch, with 115 lbs. W.A.P. (No. 9), the corresponding energy being 8,090 foot-tons. Eight 12-inch discharges with English P. powder gave *less* velocity and striking force, with *greater* expulsive pressure behind the projectiles. The 18th discharge exerted nearly double the pressure on the shot *with less* useful work. The 9th shot had evidently less "oblique movement" than any other 12-inch projectile; and every other shot did far too little work outside the gun, and far too much inside it, absorbing several hundred foot-tons of work at each discharge, to its own detriment and to that of the bore.

As the gun was designed to consume 120 lbs. of powder, the W.A.P. charges of this amount have peculiar interest. The first one, No. 15, justified Colonel Campbell, Sir W. G. Armstrong, and Sir Joseph Whitworth in fixing upon that charge for the gun. Notwithstanding the loss of power incidental to balancing projectiles upon two points, the "oblique movement of the axis" resulting therefrom, was least severe when the bore was smooth. The average pressures registered by 120 lbs. P. behind the 700-lbs. shot, when the 12-inch bore was smooth, without erosion, burrs, enlargements, &c., were only about six tons more on the square inch than those registered by 85 lbs. P. behind the 600-lbs. shot, whilst the pressure yielded by No. 15 was only three tons more.

M.L.R. gun.	Shot.	Powder charge.		Maximum pressure per square inch.			Observed velocity at 50 yards.	Remarks.
		Brand, W.A.P.	Weight.	A. Inner end of bore.	B. Vent.	C. Base of shot.		
	lbs.		lbs.	tons.	tons.	tons.	feet.	
12-in., 25-tons	600	18 May, 1870	85	18·0	16·8	15	1,290	Mean of ten rounds, except base pressure, one round.
12-in., 35-tons	700	18 Oct., 1870	120	24·4	20·1	21·6	1,309	Mean of three first 120-lbs. charges.
" "	"	" "	"	20·0	18·4	18·0	1,312	First 120-lbs. discharge, No. 15.

Taking this 15th (120-lbs.) discharge as the standard of comparison, it will be observed that the enlargement of the bore at the point where the front-stud hammers and of "driving" contact with the rear-studs had already commenced (see last column of Table II); and that the "oblique movements" of the next two shot fired under identical conditions, offered enhanced resistance to their escape, so that they did somewhat less useful work outside the gun, causing a rise of 5·4 tons in the base pressures.

The eccentricity in the velocities as compared with the irregularity in the pressures, rapidly increased as the bore roughened, culminating at the 28th discharge, when 66 tons' pressure was registered at the bottom of the bore, and 53·2 tons at the base of the shot, yielding only 621 foot-tons extra blow.

Thus, in the course of thirteen horizontal discharges, spread over five weeks, maximum pressures are evolved from two identical 120-lbs. W.A.P. charges, of 20 and of 66 tons respectively. The problem of the Surveyor-General of the Ordnance might well assume a different form, for it is not a question here of different amounts or different kinds of powder, of different elevations, or of different chamber temperatures. Every condition is identical. The gun was carefully nursed on both days. It was the third horizontal discharge on each day that we are comparing, and we may assume that the intervals between the discharges were equally large. Yet $3\frac{1}{2}$ times greater pressure is registered on one occasion than on the other. Why is this? Again I ask, has any powder-manufacturer found that carefully-made gunpowder varies in its explosive force to the extent of $3\frac{1}{2}$ times the pressure? Do shells explode with $3\frac{1}{2}$ times their wonted violence without cause? Do torpedoes manifest eccentricities to this extent? Do miners find that identical charges of similar powder, fired under like conditions, explode with $3\frac{1}{2}$ times their usual force? Vary the question as you will,

nowhere but in a Woolwich rifled gun, containing a non-centering shot balanced in unstable equilibrium upon two points, and restricted to a short rifle-bearing of 1 inch in each groove, there, and there only, do similar charges fired under like conditions, produce such anomalous results.

There are, of course, waves in a gun, just as there are waves in the sea; but when the waves of the sea singled out and engulphed a particular ship in the midst of a squadron, the common sense of seamen told them that the fault must have been in the ship and not in the waves. And when gunpowder plays such pranks in a gun, every intelligent gunner knows that it is not the gas-waves but the shot which must be at fault.

Again, we are told that it was "intense wave pressures" and "local "action" which disabled the gun. Now this 66 tons' pressure was registered more than 3½ feet from the spot where the whole of the injuries are concentrated. (Plate I.) And if the shot had centred itself in the bore, even the 53 tons' pressure on its base could not have reached within several inches of the damages; so that it is perfectly clear that it was not the direct action of the maximum powder-pressure which disabled the gun, but the mechanical movements of the shot acted upon by these great pressures,—the two forces, viz., the wriggles of the shot and the combustion of the charge, acting and reacting upon one another.

The Loss of Striking Force.—Though the loss of endurance is a serious matter, the loss of power is hardly less serious, since it compels us to reduce the charges and then to employ a gun of 35 tons' weight to do the work of one of 25 tons, and again to build one of 50 tons' weight, of still less endurance (unless it be confined to reduced charges), to do the proper work of a 35-ton gun, and, possibly, a 70-ton gun to do the work of a 50-ton one. For not only is useful work abstracted from each powder-charge, but we are compelled to employ smaller charges than the bore could usefully burn. Thus, the 35-ton gun could easily burn the 120 lbs. of P. powder, for which it was designed, but, owing to these "oblique movements of the axis of the projectile," and to the resulting accumulation of gases in its rear, the Committee report "*that* "*two rounds of such a charge* (115 lbs. P.) *will not be a dangerous* "*proof*," and the service charges are reduced from 120 lbs. to 110 and 85 lbs. P. The loss of striking force resulting (1) from the non-centering of the axes, and (2) from the reduction of powder charge, can hardly be less than 1,500 foot-tons, *i.e.*, than *from one-fifth to one-sixth that which the gun is capable of yielding.*

Thus whereas, at its own muzzle, the 35-ton gun has now barely force to perforate 12-inch armour and backing at the extreme "biting" angle, its muzzle-blow would suffice, if it had not "decidedly the "lowest velocities,"—and was not obliged to reduce its charge,—to perforate 14-inch armour and backing at the extreme "biting" angle. Two additional inches of armour perforation would thus be gained, whilst prolonging the life of this sickly "infant."

Captain Maitland, R.A., the Deputy-Superintendent of the Royal Gun Factories, stated at the Civil Engineer's Institution, last year, that "the object kept steadily in view by the authorities was to get

"the highest possible velocity out of a gun with the heaviest possible "projectile, or, in other words, to get through the thickest armour-"plate at fighting distance." And the learned Professor of Artillery stated on the same occasion, that "high velocities were most desirable, "as they gave longer ranges, more accurate practice, and greater "striking power than low velocities, and in some circumstances, such "as firing at iron-plated vessels, they were indispensable. High "velocities were fully appreciated in continental services, and by most "eminent ordnance manufacturers or inventors, such as Krupp, "Armstrong, Whitworth, Lancaster, Palliser, Scott, and others." Admiral A. Cooper Key, C.B., F.R.S., when Director of Naval Ordnance, enunciated the axiom that the first essential of a naval gun is endurance, and the second "penetrating power at ranges up to "1,200 yards."

In the face, however, of every artillery authority, and of the fact that perforating force varies as the squares of the velocities, we deliberately employ a rifling of which the official advocates themselves reported that, even when firing the same charges, it "has decidedly the lowest "velocities," and which compels us to diminish the velocity and perforation still more by reducing the powder charges far below those which the several bores could usefully consume; whilst the 7-inch gun thus reported upon, itself stated by a steel engraving of its own, that its projectiles had destroyed its bore, in their attempts to attain even "decidedly the lowest velocities." (See Plate III.)

Pressures in 25-ton Guns.

But do other French or miscalled "Woolwich" rifled guns suffer in this way? Certainly they do; but the mischief increases with the weight of the shot to be projected, inasmuch as the rifle-bearing in each groove is less for a 700-lbs. shot than for a 115-lbs. projectile. Every heavy studded projectile which is fired is so injured in "wabbling" its way out of the gun, that it is obliged to be melted up. Now these heavy projectiles cost a good deal of money; 12-inch ones cost, for example, nearly £5. Are five-pound notes so plentiful that anybody can afford to burn them lightly, or without good cause? Is not this re-melting of recovered projectiles sufficient evidence that unmechanical contrivances have been absorbing work within the bores that ought to have been acting on hostile armour?

What mean those "local enlargements, dents, and even occasionally "cracked tubes," testified to by the Special Committee,* as the result of proving guns with only $1\frac{1}{4}$ times their diminished or miscalled "battering" charges?

The Committee on Explosives tell us† "that, with a 12-inch calibre, "the (25-ton) gun would probably consume 95 lbs. of powder with as "good useful effect per lb. of powder, and with no greater pressure per "square inch than it does 85 lbs. of powder with an 11-inch calibre." Why, then, are the miscalled "battering" charges of this gun 10 lbs.

* "Extracts of Artillery Proceedings," &c., vol. x, Part II, page 81.
† "Report" of 1st April, 1872, p. 3.

below its powers of combustion? Simply because, even with 85-lbs. charges and 600-lbs. shot, the maximum pressures vary from 14·4 to 20·5 tons on the square inch; and with 95 lbs. there is no saying what they might jump to.

Why should 600-lbs. shot in a 12-inch bore yield so much higher pressure than 700-lbs. shot in a similar bore? Does the gunpowder know instinctively that the weight of the gun is less? Does a short 12-inch gun 12 calibres in length, consume its charge better than a longer 12-inch gun of $13\frac{1}{2}$ calibres? Or, is it not capable of easy demonstration, that the mechanical action of the shorter 600-lbs. shot about its rear-studs is more lively than that of the longer shot?*

The loss of endurance in the 25-ton gun is so great, that not one of the class has been subjected to an ordeal anything like what they would have to undergo in a naval bombardment; whilst the loss of velocity and striking force is such that, properly rifled, the 12-inch 25-ton gun would perforate the "Glatton's" turret easily, and penetrate whatever the present 35-ton gun can penetrate.

Pressures in 18-ton Guns.

The influence of length upon the "oblique movements" of the shot was evidenced by the 10-inch gun experiment with similar charges behind projectiles of varying length and weight.† The weights of the projectiles varied from 300 to 1,200 lbs., and it was found that with similar charges of P. the additional weight of shot, after 450 lbs., gave very trifling increase to the powder pressure, whilst the regularity of the pressures and the correspondence of the velocities was much enhanced. The results were still more confirmatory when the more violent quick-burning R.L.G. was used, for the wriggling movements of the short 300-lbs. shot caused higher pressures than those of the longer 600-lbs. shot, using the same (60-lbs.) charges; thus justifying the Official Report‡ that "when *any description of powder is increased* " beyond a certain limit, wave or local pressures are set up which strain " the gun unduly, *without affording an equivalent of useful effect on the* " *projectile.*" Clearly, then, in the judgment of the Committee, the " description of powder" has nothing whatever to do with the erratic relations between the pressures and velocities.

Firing its ordinary 70-lbs. P. and service 400-lbs. shot, the pressures in the 10-inch 18-ton gun show to a slighter extent the operation of similar mechanical forces within; but when the proof charge, $87\frac{1}{2}$ lbs. P., was used, the eccentricity was quite as remarkable as in the 35-ton gun, the pressures rising to 63·4 tons. 29·8 tons per square inch pressure on the base ejected the shot with three feet *more* velocity than it had when driven out by 12 tons per square inch higher expulsive force. Clearly there was an enormous extra force applied to the shot which must have been conveyed by it, through its studs, to the gun, inasmuch as it did not carry this extra force out of the bore.

As might be expected, the quicker burning and more violent R.L.G.

* The mechanical action here referred to is the "oblique movement of the axis," not the rotatory force.

† "Extracts of Artillery Proceedings," vol. x, Part II, page 84.

‡ See "Report of Committee on Explosives," 1st April, 1872, page 7.

powder was even more erratic than the P. For, with the service 60-lbs. R.L.G. charge, the expulsive pressures on the base varied from 22·5 to 33·9 tons, without any adequate increase of velocity. And when the proof 75-lbs. R.L.G. charge was employed, the maximum pressures jumped to 66·8 tons, exceeding any registered in the 35-ton gun, but without the slightest damage to the powder-chamber. Are the guns then uninjured by these irregularities? No. The lands and grooves which are traversed by the projectiles, but are not subjected to these excessive powder-strains, are marked "by local enlargements, dents, and even "occasionally cracked tubes." The position of all these abrasions clearly shows that they must have been made by the projectile, and the only part of the projectile which is supposed to touch the bore is the stud. (Plate II.) Obviously, wherever a stud makes a dent or local enlargement, the process of making it must check the exit, and the projectile must endeavour to revolve on that point, and, doing so, must wriggle with such severity as to still further obstruct its own escape, giving extra time for the more perfect combustion of the charge and causing the gases in the rear to accumulate.

Even when such small (40-lbs.) P. charges were employed that the maximum pressures did not exceed ten tons on the square inch, the expulsive forces were occasionally highest when the velocities were lowest. But for this, the 10-inch gun might consume 87½ lbs. of powder with advantage, striking a blow several hundred foot-tons heavier than at present; in fact, perforating armour which we are now obliged to employ a 25-ton gun to perforate.

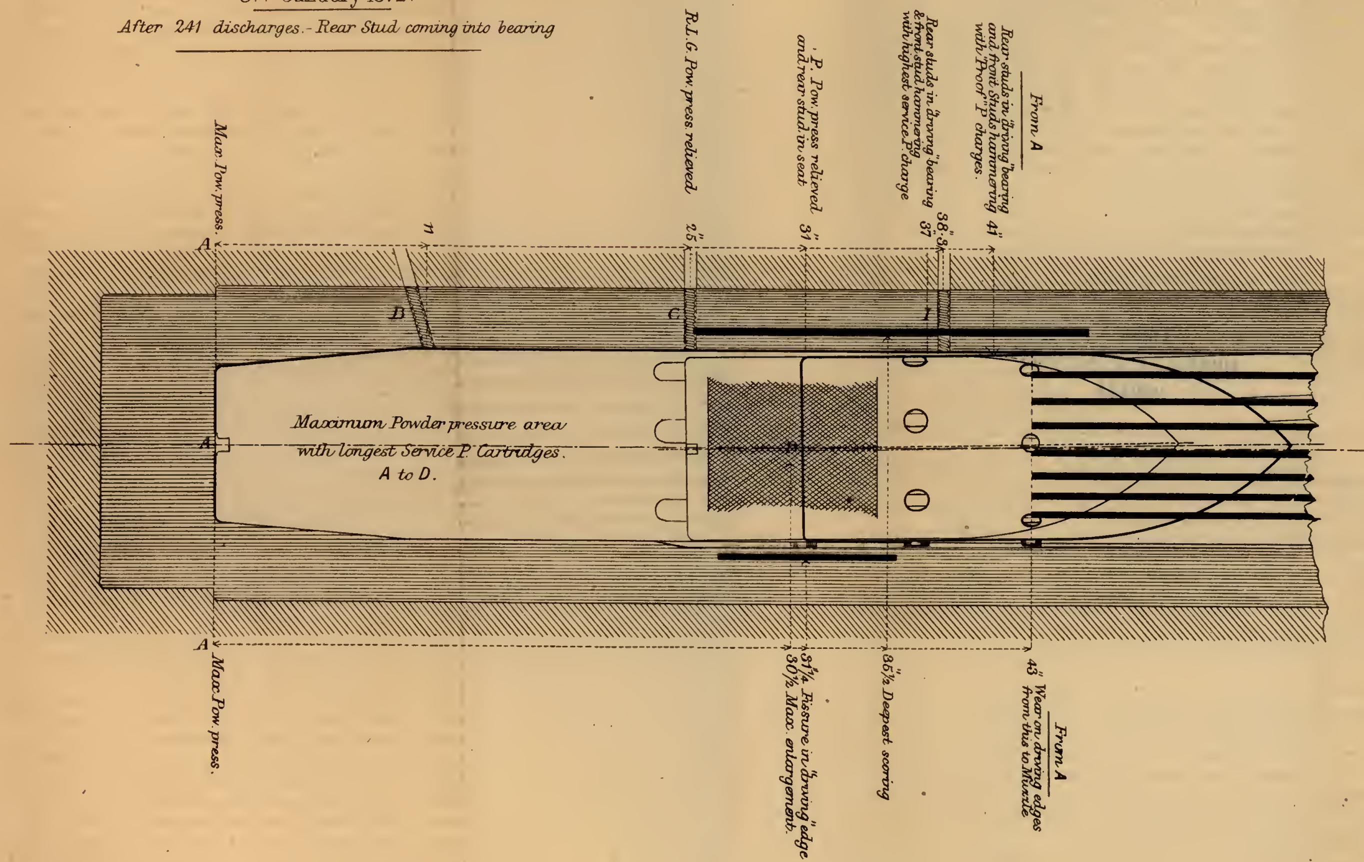
Powder charge. 10 in. 400-lbs. shot.			Observed velocity at 50 yards.	Maximum pressure per square inch.				Striking force at 50 yards.	Position of base of shot when maximum powder pressure was registered. Plate II.
Brand.	Weight.	Length of cartridge.		A. Inner end of the bore.	B. 11 ins. from inner end of the bore.	C. 25 ins. from inner end of the bore.	I. 38·3 ins. from inner end of the bore.		
	lbs.	in.	feet.	tons.	tons.	tons.	tons.	foot-tons.	
W.A.P..	70	25	1,413	23·7	21·3	20·9	19·9	5,539	Halfway between C and I.
„	„	„	1,431	22·5	22·6	22·7	12·0	5,675	
W.A.P..	87½	29	1,527	25·0	29·8	30·0	29·8	6,466	Nearly at I.
„	„	„	1,524	63·4	41·6	37·0	41·9	6,443	
R.L.G...	60	25	1,317	57·8	29·4	31·1	18·2	4,807	At C.
„	„	„	1,325	36·5	27·0	22·5	16·5	4,868	
R.L.G...	75	28	1,388	41·8	22·8	21·3	16·6	5,344	Three inches outside C.
„	„	„	1,426	66·8	28·0	35·0	28·1	5,635	
W.A.P..	40	—	996	9·0	8·7	9·9	7·8	2,750	At C.
„	„	—	1,006	8·8	9·2	8·8	8·5	2,807	
W.A.P..	70	25	1,345	19·3	19·0	19·0	16·5	5,021	Halfway between C and I.
„	„	„	1,360	20·1	18·8	17·1	16·3	5,128	

Interior of

10 INCH 18 TON M.L.R. EXPERIMENTAL GUN Nº 375.

3rd January 1872.

After 241 discharges.- Rear Stud coming into bearing



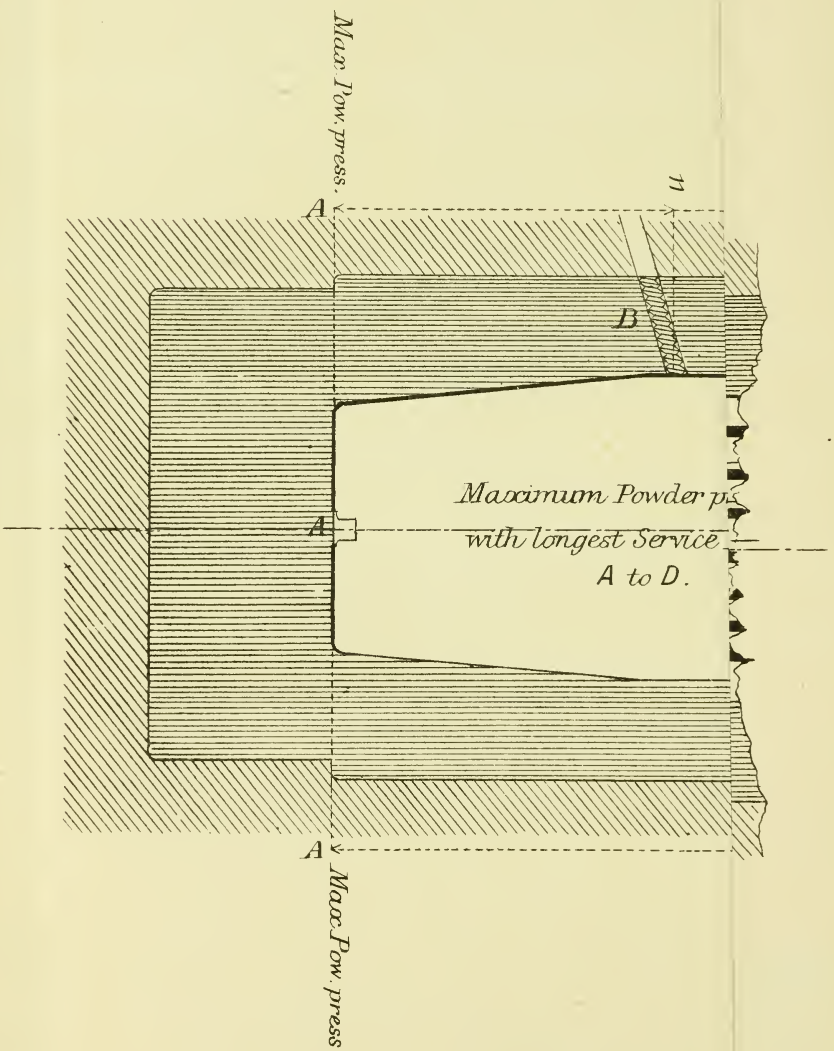
J. Jobbins

Interior of

IO INCH 18 TON M.L.R. EXPERIMENTAL

3rd January 1872.

After 241 discharges.- Rear Stud coming



J. Jobbins

The state of the bore (Plate II) of this 10-inch 18-ton gun (Expl. No. 375), after the pressures were registered, shows that the studs had made and had to pass over a maximum enlargement of upwards of one-tenth of an inch in front of their seat, roughness of the bore, the deepest furrows of which were about the same spot, a fissure on the driving edge of the left groove, and wear on the driving edges of all the grooves: and this though only 241 rounds had been fired at wide intervals of time and horizontally, at the date of the examination, viz., 3rd January, 1872. Though these marks and injuries were not in themselves of a vital character, they would greatly intensify the force of the "oblique movements of the axis" of the 400-lbs. projectiles about their studs, and enhance the eccentricity of the maximum pressures with identical powder charges.

In Plate II, the 400-lbs. shot is shown in its seat with the longest service P cartridge, and again, in the corresponding position with the rear-studs coming into "driving" bearing. With the shorter cartridges, the rear-studs would be nearer the inner end of the bore. As illustrated, the seat of the rear-studs correspond with the centre of the maximum enlargement.

State of the 10-inch bore. Expl. No. 375, 3rd. January, 1872. (See Plate II.)		Distance from inner end of bore. Extremes.	Centre.	Vertical position in the bore.
Fissure in "driving" edge of groove		26½ to 36 in.	31¼ in.	left groove
Wear on "driving" edges of grooves		43 to 145 "	94 "	all grooves
Maximum roughness, or deep scoring		25 to 46 "	35½ "	up
Maximum enlargement about ·1 inch		26 to 35 "	30½ "	round
Rear-stud in seat................	According to length of cartridge.	26 to 30 in.	28 in.	down
Rear-stud coming into "driving" bearing	According to length of cartridge.	32 to 36 "	34 "	round
Front stud hammering	According to length of cartridge.	32 to 36 "	34 "	up
Maximum P. powder pressure area	According to length of cartridge.	27 to 31 "	29 "	—

Colonel Campbell testified to the Ordnance Council, 4th May, 1870, that the Woolwich "system has the great disadvantage of local "scoring." And Mr. Bashey Britten told the Institution of Civil Engineers, that "those who had seen the inside of a Woolwich gun which "had done much work, would know that for from 12 to 24 inches from "the cartridge, the bore sometimes became as rough as the bark of a "moderate-sized elm tree; and it was up such a surface that the hard "studs had to slide. If the rifling acted uniformly, the pressures on "the gun would vary constantly with the *vis viva* imparted to the "shot; but in nearly all cases when extraordinary pressures were "detected, less *vis viva*, instead of more, was acquired by the projectiles. " * * * * The liability of the studs to get jammed "was necessarily increased under such circumstances, and then they "could only be released by the pressure gathering behind them. The

"velocity of the shot might therefore be expected to be less, while the "strain was greater."

Powder Pressures in the 11-*inch* 18-*ton Gun, Expl. No.* 375.—The injuries to the 10-inch bore (No. 375) were got rid of by boring it out to 11 inches calibre; and certain comparative experiments were made with 11-inch 400-lbs. projectiles. The larger the bore, the more perfect and regular the combustion of equal weights of powder, and the less violent the action upon the studs. Hence larger charges can be employed in larger bores with less "wabbling," and therefore lower and more regular pressures. Thus the 400-lbs. shot gave, with 85 lbs. P. charge, in an 11-inch bore, $8\frac{1}{2}$ per cent. *less* pressure, and 16·7 per cent. *more* work than when propelled by 70 lbs. P. powder in a 10-inch bore. The initial energy per inch of the shot's circumference being with the 11-inch shot 172·2, and with the 10-inch shot 161·8 foot-tons, or a total muzzle-blow of 5,855, and 5,016 foot-tons respectively; and the corresponding mean maximum pressures at the inner end of the bore, 17·8 and 19·4 tons per square inch.

Though the 11-inch bore, being fresh from the factory, had a polished surface, free from dents, abrasions, roughnesses, and wear on the edges of the grooves, and was, therefore, most favourable to regularity of action; still the "oblique movements of the axis of the projectile" are traceable in the milder pressures registered with the 11-inch 400-lbs. shot, *e.g.*, 14·9 tons per square inch expulsive force on the base of the shot yielded 5,800 foot-tons blow, but nearly 2 tons per square inch *more* pressure gave, under apparently identical conditions, 43 foot-tons *less* blow, and nearly 1 ton *more* pressure yielded 157 foot-tons *lighter* blow.

P. Powder charge. 11-inch 400-lbs. shot.	Observed velocity.	Pressure by Crusher-gauge per square inch.				Striking force.	Position of base of shot when maximum pressure was registered.
		A. Inner end of bore.	B. 11 ins. from inner end of bore.	C. 25 ins. from inner end of bore.	I. 38·3 ins. from inner end of bore.		
	feet.	tons.	tons.	tons.	tons.	foot-tons.	
85 lbs., lot 863 ...	1,484	19·3	18·3	19·4	14·0	6,109	About halfway between C and I.
" " ...	1,465	18·1	17·0	18·0	12·6	5,952	
" " ...	1,466	20·7	16·0	15·6	14·0	5,961	
85 lbs., lot 1,404 ..	1,441	17·2	16·3	16·8	12·5	5,757	
" " ..	1,433	16·4	16·1	13·3	13·1	5,692	
" " ..	1,427	15·6	14·9	15·6	12·3	5,643	
" " ..	1,446	16·5	15·3	14·9	12·5	5,800	

NOTE.—See Mr. Bashley Britten's very able and instructive reply to the discussion at the Institution of Civil Engineers, appended to his paper on "The Construction of Heavy Artillery."

Powder-Pressures in other Heavy Guns.

As every heavy projectile is damaged in escaping out of the bore, each shot must divert mechanical force to that object, and the necessary result is, that a great many guns have been more or less injured in slow firing with diminished charges of powder at low elevations during the past eight years. The Ordnance Inspector's Reports on these numerous injuries must be very bulky and dry literature. Yet, in the interests of the public service, I volunteered, at my own cost and labour, critically to examine the whole of those records, with the view of tabulating the positions of the several damages, in the hope of thus showing in each case how, when, and where the mechanical forces were misapplied, with the corresponding loss of endurance and of striking force, and I requested the oversight and approval of the Director of Artillery to such extracts as I might be permitted to make.

This laborious undertaking, which could be no possible personal benefit to myself, I would have performed gratuitously, free of cost to the State, in the hope of elucidating the mechanical forces in operation in each case, and, by studying the mechanical disease, arriving at such a mechanical remedy as would contribute to the efficiency and credit of the Service and to the safety of the country. But access to these official records was denied me. Why? Would they reveal anything unknown to the profession?

However, where so many guns are disabled and others injured every year, facts will ooze out; and I have examined the official records of a considerable number of marked and damaged bores. Moreover, I have studied, for sixteen months, the connection between the marks upon the bore and upon the projectiles, and variations in the Practice Tables and Powder-Pressures. I find that, in general, the principal marks in the bores are in one of two positions, viz., either a few inches in advance of the seat of the rear-studs, where they come into "driving" bearing, and where the front-stud hammers; or near the muzzle where the front-studs are intended to do their share of the work. There is also, of course, the roughness or erosion which is greatly intensified by the stud-system, as Colonel Campbell pointed out to the War Office Council on the 35-ton gun, saying—"The system has the great disadvantage of local scoring." A worn gun usually gives out less useful work on the target, combined with higher pressures in the chamber.

These things are so well known, that many shot fired from the 8-inch and other experimental guns have no studs at all. These particular guns have, therefore, shown great apparent endurance; but powder-pressures registered when the shot are unrifled afford no criterion whatever as to the pressures arising from "the oblique movements of the axis of the projectile" about its studs. The unstudded shot do not centre in the bore, and their pressures would, in consequence of the body of the shot being below the axis of the piece, and being in contact with the bore, vary according to the presence or absence of fouling matter in the gun. These pressures ought, therefore, to be higher but somewhat less erratic than when studs are employed.

Incautious students are apt to be betrayed into erroneous conclusions both as to endurance and as to pressures in these experimental guns, from ignorance of the above fact, which is not always stated in the published tables.

Mr. Bashley Britten pointed out at the Institution of Civil Engineers, last year, that " there was no reason why gunpowder should not act as " uniformly in rifled guns as in smooth bores, unless the rifling and the " projectiles were designed on unscientific principles. A rifle shot " had to perform in a gun the functions of a screw; and the power to " turn a screw working properly was definite and constant. If it " could not follow the thread it worked in, but overrode the sides, it " became locked. * * * The instant a shot was checked " by any obstacle in its course through the bore, the *vis viva* of the " column of gas moving in one direction was necessarily converted into " pressure on the gun. The 'grip at the muzzle' in the Armstrong " shunt gun was found to produce sufficient check to cause concussion- " fuzes, having movable strikers, to explode at the muzzle. The first " four 600-pounders were shunt guns, each costing £4,000, and weighing " 23 tons. In the official Text Book it is stated 'of these four, by " 'March, 1867, two were rendered unserviceable during experimental " 'practice at Shoeburyness, by splitting their A-tubes and some of " 'the coils, and another by splitting its outer coil.' A 9-inch shunt " gun burst into 42 pieces on one occasion, at the 402nd round. These " failures were officially attributed to the shunt rifling." Similarly a 9-inch 12½-ton "Woolwich" gun exploded into many pieces at the first "proof"-round in 1868; and a 7-inch 68-pounder "Woolwich" rifled gun exploded into 76 pieces, scattered over an area of 580 yards by 150 yards, in 1870, at the 165th round.

All "intense wave pressures," say some! But why at the 165th round? Oh! the powder was all wrong. But the committee say that " any description of powder" used in large charges is liable to these erratic and unaccountable "wave pressures." Is "any description of" *gun* subject to such irregular "wave pressures," except a Woolwich rifled one? 30-lbs. charges were used in the exploded 7-inch 68-pounder; do 35-lbs. charges in 12-inch shell play such extraordinary pranks?

Studs in Uniform Spirals.—Where uniform spirals are adopted in connection with short-bearing studs, balancing the shot nearly under the centre of gravity, the tendency to "oblique movements of the axis " of the projectile" about its studs is equally present; whilst the absence of that ever-increasing resistance peculiar to the ever-increasing spiral, is evidenced by the tendency of the studs to hammer intermittently against the uniform grooves, and thus to mark themselves in steps, instead of in the wedge form peculiar to the accelerating twist. The injuries thus inflicted upon the uniform-twist bores are necessarily either at or in advance of the seat of the short-bearing studs, showing that the guns are not destroyed by the powder but by the projectile. True, the uniform spiral gives the studded shot a greater velocity, in consequence of the absence of that ever-increasing resistance which reaches its maximum in the ever-changing angle of spiral when the

shot is at its highest speed. But the short-bearing stud, even with an uniform twist, gives less velocity and perforation than the long-bearing centering shot, proving that work is taken up in the bore to the destruction of both projectile and gun. The position of the injuries in such uniform-spiral stud guns verifies the writings in the steel bores of increasing-spiral guns. As samples of the injuries inflicted by studded projectiles after 500 rounds from each gun, take the following 7-inch uniform-spiral guns:—

	Expl. No. 200, 7-inch gun, May, 1872.			Expl. No. 198, 7-inch gun, May, 1872.			Expl. No. 299, 7-inch gun, May, 1872.			Expl. No. 199, 7-inch gun, May, 1872.		
	Distance from inner end of bore.		Vertical position in bore.	Distance from inner end of bore.		Vertical position in bore.	Distance from inner end of bore.		Vertical position in bore.	Distance from inner end of bore.		Vertical position in bore.
	Extremes.	Centre.		Extremes.	Centre.		Extremes.	Centre.		Extremes.	Centre.	
	Inches.	Inches.		Inches.	Inches.		Inches.	Inches.		Inches.	Inches.	
Much wear on "driving" edge of groove.	23½ to 41	32¼	Down	13½ to 19	16¼	Down	12 to 22	17	Down	12½ to 20	16¼	Down
Slight wear on "driving" edge of two other grooves	14½ to 21	17¾	Up	—	—	—	—	—	—	—	—	—
Bore grazed by projectiles	39 to 48	43½	Up	—	—	—	34 to 47	40½	Up	39 to 46	42½	Up
Ditto ditto ..	20 to 24½	22¼	Left	16½ to 19	17¾	Left	35 to 44	39½	Up	12¾ to 14¼	13½	Up
Indentation..........	—	14¾	Down	—	—	—	—	—	—	—	—	—
Maximum roughness, or deep scoring	17 to 35	26	Up*	11½ to 29½	20½	Up	10½ to 21	17¼	Up	10 to 25	17½	Up
Ditto ditto ..	16 to 31	23½	Down	10 to 22½	16½	Up	13½ to 24½	19	Down	14½ to 21	17¾	Down
Maximum enlargement	(·125 in.)	22	Round	(·029 in.)	16	Round	(·039 in.)	16	Round	(·039 in.)	16	Round
Gun re-vented	Five times.						Twice.			Twice.		
According to length of cartridge:												
Rear-stud in seat	11 to 14	12½	Down	11 to 14	12½	Down	11 to 14	12½	Down	11 to 14	12½	Down
Rear-stud coming into "driving" bearing	13 to 16	14½	Round	13 to 16	14½	Round	13 to 16	14½	Round	13 to 16	14½	Round
Front stud hammering	15½ to 18½	17	Up	15½ to 18½	17	Up	15½ to 18½	17	Up	15½ to 18½	17	Up
Maximum powder pressure area	15 to 18	16½	(P.)	9¼ to 12¼	10¾	(R.L.G.)	9¼ to 12¼	10¾	(R.L.G.)	9¼ to 12¼	10¾	(R.L.G.)

* No. 200 was very much scored and enlarged. The scoring was so extensive that the gun had to be subsequently turned over, so that the hammering and scoring might change places.

Velocities in Uniform-Spiral 12-pounders.—The French Government have been trying the uniform-spiral Woolwich system against the long radial-bearing rib of Vavasseur, which is similar in its mechanical action to Scott's centering system. Two, otherwise identical 12-pounders, rifled on these two methods, were tried at Bourges last year, when the "Woolwich" stud projectile had, as usual, "decidedly the lowest "velocities," escaping with 16 feet less initial speed, and attaining 338 yards less range, with less accuracy, when the long-bearing one reached 3,760 yards; thus showing—1. That useful work had been absorbed in the short-bearing gun; and 2. That further useful work was abstracted by imperfect rotation in the air.

The Woolwich-made 9-pounder presented to the French Government is somewhat heavier than the above guns, and throws a 9-lbs. projectile with $1\frac{3}{4}$ lbs. R.L.G., which is a proportionately heavier charge. The turned shot supplied with this gun from the Royal Arsenal have been fired at Bourges, and are now being rifled by Messrs. Vavasseur with long-bearings for the French Government, to be fired from the Vavasseur 12-pounder, as a conclusive comparative experiment.

M. J. Vavasseur has permitted me to verify the following figures by comparing them with the original letter of the President of the French Commission on Artillery at Bourges:—

Données relatives aux Canons Vavasseur et de Woolwich Expérimentés a Bourges en 1872.

Provenance des Canons.	Canon.							Projectile.				Charge.			Vitesse initiale.	
	Poids.	Ame de la pièce		Système.	Rayures.							Poids.			Par seconde.	
	En kilogrammes.	Longueur.	Diamètre.		Profondeur.	Largeur.	Pas en calibre.	Diamètre.	Longueur.	Poids.	Surface extérieure.	Livres Anglaises.	Kilogrammes.	Sorte de poudre.	Pieds Anglais.	Mètres.
		m.	mm.		mm.	mm.		mm.	mm.	k.						
Vavasseur à rayures, No. 730	413	1·612	76·2	Woolwich—3 rayures ..	2·79	20·32	25	74·68	241	5·443	brute de fusion.	2	0·907	R.L.G.	1255	382·8
Vavasseur à côtes saillantes, No. 743	413	1·612	76·2	Vavasseur—3 côtes	4·45	10·16	25	74·68	241	5·443	brute.	2	0·907	R.L.G.	1271	390·4

Résultats des Expériences comparatives faites à Bourges des Canons Vavasseur et de Woolwich.

Constructeurs des Canons.	Nombre de Coups.	Portée moyenne. P.	Ecart longitudinal moyen. E.	Dérivation moyenne. Δ.	Ecart latéral moyen. D.	Coefficient de justesse. En direction. $R = \frac{D}{P}$	Coefficient de justesse. En portée. $G = \frac{E}{P}$	Dimensions du rectangle comprenant tous les coups. Longueur.	Dimensions du rectangle comprenant tous les coups. Largeur.	Observations.
Angle de tir 12°. Vent faible.										
Vavasseur à rayures, No. 730	12	3421·6	115.72	23.62 Dr.	17.89	0.0052	0.0338	512	37.2	
Id. à côtes saillantes, No. 743 .. .. Couchon conique en zinc.	12	3760	88.44	13.57 „	10.84	0.0028	0.0235	365	65.0	
Id. à côtes saillantes, No. 743 .. .. Mécanisme percutant.	12	3754	44.53	12.89 „	12·518	0.0033	0.0118	159	34.9	
Angle de tir 14°. Vent faible.										
Vavasseur à rayures, No. 730	14	3767.1	84.68	15.22 Dr.	5.39	0.0014	0.022	508	31.4	Un obus brisé dans l'âme.
Id. à côtes saillantes, No. 743	15	4088.6	47.95	46.52 „	5.71	0.0014	0.012	189	27.8	
Angle de tir 16°. Vent faible.										
Vavasseur à rayures, No. 730	14	4125.4	123.1	1.17 Dr.	6.19	0.0015	0.030	434	27.7	Un obus brisé dans l'âme.
Id. à côtes saillantes, No. 743	15	4420.9	101.5	43.43 „	5.45	0.0012	0.023	373	23.7	

NOTE.—Les expériences pour chaque angle de tir sont faites le même jour et toutes les circonstances extérieures sont identiques pour chaque canon.

The Original 7-inch "Woolwich" Gun.

Nothing has occurred to the 35-ton gun that might not have been predicated from the performances of the original 7-inch "Woolwich" gun in 1865. It had an increasing spiral, and a study of its Practice Tables, in connection with the Ordnance Inspector's Report, shows that:—

1. 70 per cent. of the recovered shell were found injured.

2. The struggles of the projectiles to escape from the ever-changing angle of spiral, destroyed the bore in 567 discharges.

3. So much force was absorbed through the studs in the destruction of the bore and projectiles, that the increasingly-resisted shot had "decidedly the lowest velocities," striking 220 foot-tons less muzzle blow than the competitive oval-bore, and 133 foot-tons less than the competitive long-bearing iron-ribbed shot.

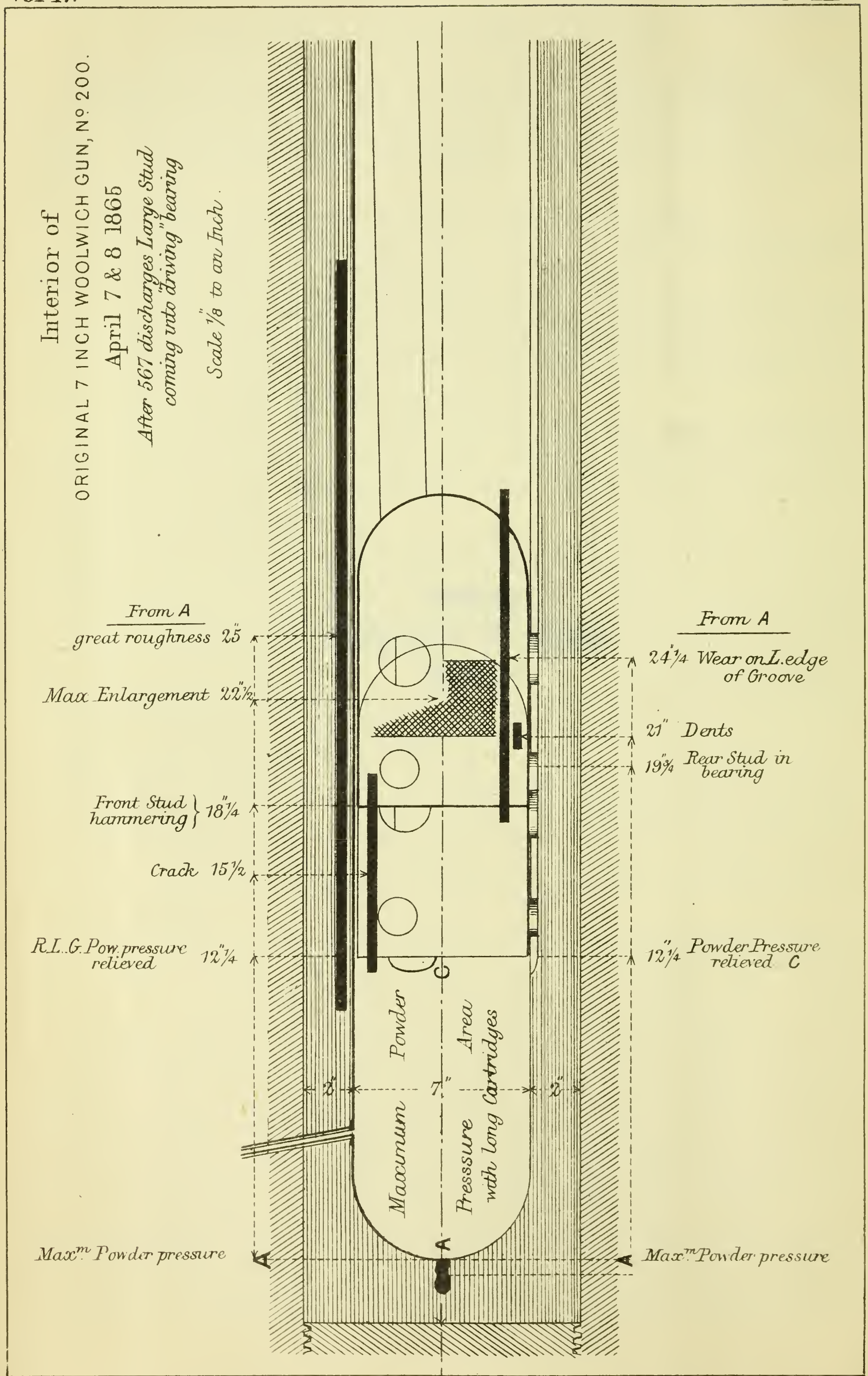
4. The studded shot had a higher trajectory within 1,500 yards (the fighting distance), and to drive it so far, with the same elevation, took one-fourth (5 lbs.) greater weight of powder than did its competitive long-bearing iron-ribbed shot.

5. The studded projectiles were slightly less accurate than the iron radial-bearing ones at Admiral Key's fighting range.

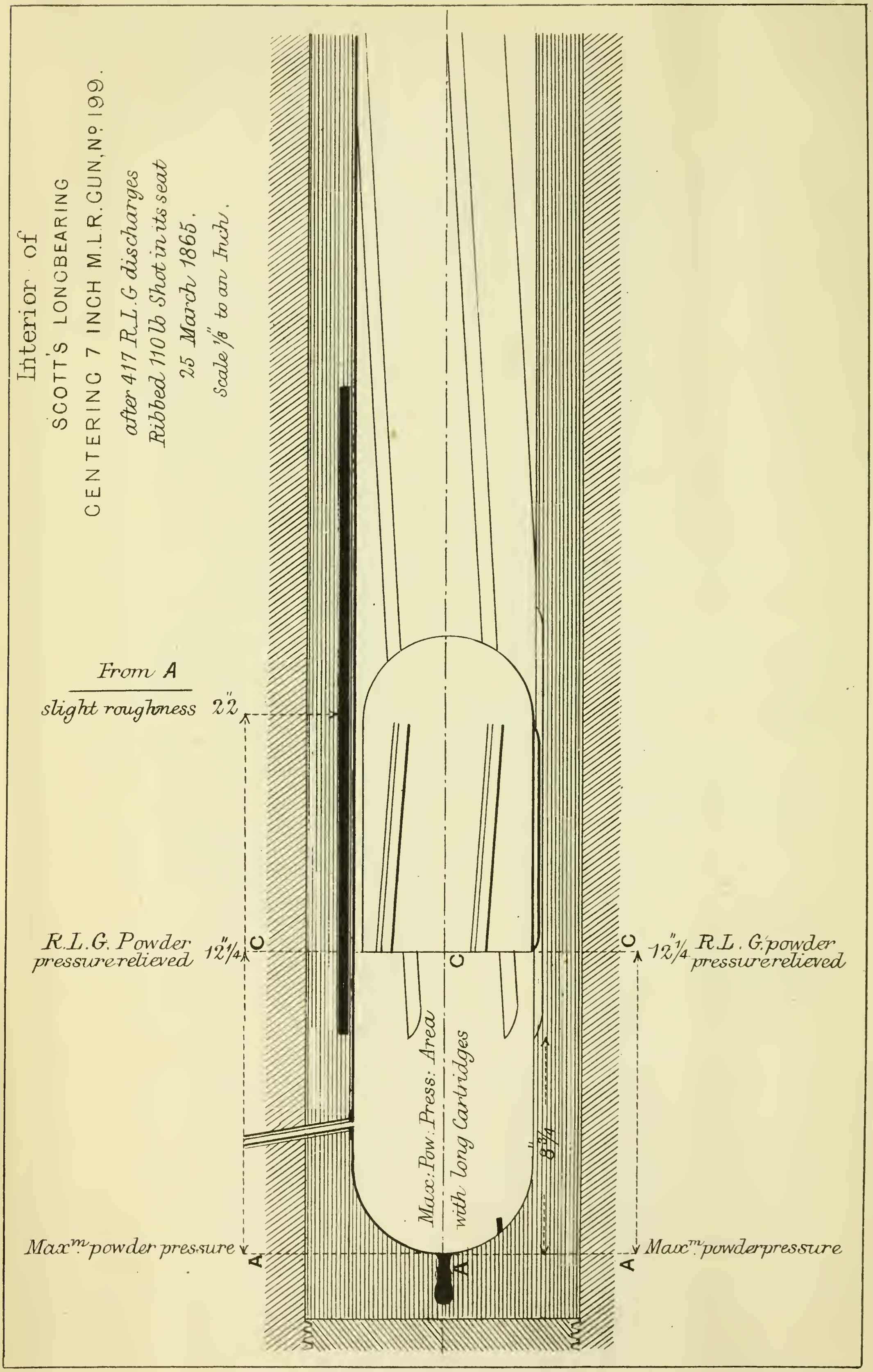
On the other hand, the iron radial-bearing projectiles were uninjured, and their lands and grooves were left so perfect that this 7-inch gun was bored up to 8·03 inch calibre to throw shot of 180 lbs. weight instead of the 110 lbs. ones for which it was designed; thus showing a direct relation between endurance and useful work, and that, under otherwise identical conditions, "decidedly the lowest velocities" is the natural result of decidedly the worst endurance.

The powder-pressures were not registered in the original 7-inch Woolwich gun; but the Ordnance Inspector's Report shows that the position of the damages to the grooves and lands corresponded very nearly with the position of those in the 35-ton gun. (Plates I, III.) It seems, then, not unlikely that similar irregularities occurred in the powder-chamber.

The maximum powder pressure area in the original Woolwich 7-inch gun (using R.L.G.), extended from 9 to 18 inches from the bottom of the bore according to the cartridge in use. (Plate III.) The "driving" stud was sometimes in front and sometimes in rear. The elongated projectiles varied from $11\frac{1}{2}$ to 13·88 inches in length, and from 94 to 110 lbs. in weight, and the charges from 12 to 25 lbs. R.L.G. Striking a mean between these quantities, it will be seen that the principal destructive agencies operated very nearly as in the 35-ton gun. The vital cracks in both guns correspond with the spot where the front-stud hammers. The maximum enlargements, the abrasions, &c., in both guns agree as usual with the point of "driving" contact of the driving studs. No marks are recorded outside or inside these points, excepting certain chamber defects in the original Woolwich gun, the result of malformations subsequently remedied, and "the disadvantage of local "scoring." This tender relationship between the first, and, I hope,


Interior of
ORIGINAL 7 INCH WOOLWICH GUN, No. 200.
April 7 & 8 1865
After 567 discharges Large Stud coming into "driving" bearing
Scale 1/8" to an Inch
From A
great roughness 25"
Max Enlargement 22 1/2"
Front Stud hammering 18 1/4"
Crack 15 1/2
R.L.G. Pow. pressure relieved 12 1/4"
Max.m Powder pressure
From A
24 1/4 Wear on L. edge of Groove
21" Dents
19 3/4" Rear Stud in bearing
12 1/4" Powder Pressure relieved C
Max.m Powder pressure
2"
7"
2"
C
A
A
A
Maximum Powder Pressure Area with long Cartridges

J. Jobbins


Interior of
SCOTT'S LONGBEARING
CENTERING 7 INCH M.L.R. GUN, No 199.
after 417 R.L.G discharges
Ribbed 110 lb Shot in its seat
25 March 1865.
Scale 1/8" to an Inch.
From A
slight roughness 22"
R.L.G. Powder pressure relieved 12 1/4"
12 1/4" R.L. G. powder pressure relieved
C
C
C
Max: Pow: Press: Area with long Cartridges
8 3/4"
Maxm. powder pressure
Maxm. powder pressure
A
A
A

J. Jobbins

the last of the miscalled Woolwich rifled guns—the venerable parent and delicate infant—ought not to pass unnoticed.

Plate III shows the original 7-inch Woolwich gun after its destruction, with the shot in its seat, and with the rear-stud coming into "driving" bearing, when long cartridges were employed. With shorter cartridges the positions of the shot would be nearer the powder-chamber.

Contrasting Plate III with Plate IV, which shows the competitive Scott long-bearing centering 7-inch gun after the last shot, it will be observed that, in the Scott gun, "*there is no apparent expansion* "*of the bore*," no cracks, no dents, and no wear on the edges of the grooves; whilst the roughness or erosion from the escaping gases is stated by the Ordnance Inspector to have been "slight." The chamber defects in both guns were the result of the hemispherical form of the inner end of the bore, and was common to all four competitive guns. One of the other guns had its chamber squared at the end, after 40 discharges, and the eating way in the axis was entirely stopped. The hole at the axis of the chamber, shown in Plate IV, was subsequently plugged up in Scott's gun, and the barrel bored up to 8·03 inch.

See Plates III and IV.	Original Woolwich 7-inch gun, (No. 200), 7th and 8th April, 1865.			Scott's long-bearing centering 7-inch gun, (No. 199), 25th March, 1865.
	Distance from inner end of bore.		Vertical position in bore.	Position in bore.
	Extremes.	Centre.		
	Inches.	Inches.		
Longitudinal crack	11½ to 19½	15½	Up	None
Dents in lands and grooves	20½ to 21½	22½	Down	None
Wear on *loading* edge of groove	17½ to 31	24½	Down	None
Roughness or deep scoring	10 to 40	25	Up	9 in. to 35 in. from A. (slight)
Maximum enlargement, ·049 to ·042 in.	21 to 24	22½	Round	"*There is no apparent expansion in the bore*"
Slight fissures at vent	—	—	Up	Up
Defect from malformation of chamber	—	—	Axis	Axis, and 1¼ in. from A.
Base of shot in its seat (According to length of cartridge.)	9 to 18	—	—	9 to 18 in. from A.
Front stud hammering (According to length of cartridge.)	—	18¼	Up	Uniform spiral and long-bearing centres in the bore at starting.
Rear-stud coming into bearing (According to length of cartridge.)	—	19¾	Round	
Maximum powder pressure area (According to length of cartridge.)	0 to 18	—	—	0 to 18 in.

Conclusion.—I have patiently examined, seriatim, every pressure registered in the first 35-ton gun, and I have found that every variation of pressure, where similar charges were ignited under identical conditions, is traceable to the unmechanical method of balancing the shot on two points nearly under its centre of gravity, limiting the rifle-bearing to one inch in each groove, and not centering the projectile in the bore, an absurd contrivance which Mr. Charles Merrifield, F.R.S., the distinguished Principal of the School of Naval Architecture, recently described to the British Association, adding that "the consent "of all mechanicians and engineers with whom he had ever conversed "was absolutely unanimous in the condemnation of the Woolwich "system of rifling, and that he had never heard any serious defence of "it."

During the last sixteen months, I have myself consulted eminent mechanical engineers, manufacturers of guns, of powder, and of projectiles, scientific artillerists, and mathematical professors on every mechanical detail as it arose, communicating alike with those who are committed to this as well as to other systems. These gentlemen have instructed and aided me much, opening to me freely their rich stores of knowledge and experience; some have corrected my erroneous impressions, and to all I owe grateful thanks. But amongst all these experts, I did not come across a single unqualified supporter of the present system of rifling. Certain able and distinguished soldiers had opinions in favour of "the increasing spiral" on which the whole of these evils rest. But when I privately and publicly importuned them for a single reliable fact in support of "the increasing spiral," they had not the shadow of a fact to allege,—nothing but "the baseless fabric of a "vision." Some imaginative individual had made a guess that the maximum pressure in the powder-chamber and the destruction to the gun, would be materially lessened if an increasing spiral were employed, and some dabbler in mathematics conclusively proved that if x and y were cleverly manipulated, powder and mechanical laws must follow wherever those two unknown quantities are directed. But not a single experiment was made to test the correctness of this guess.

Eight years have been spent in trying to make the laws of nature conform to this arbitrary guess. All the talent of Woolwich Arsenal has been concentrated on the problem. Every nature of gun produced has had a different form of increasing spiral. Hundreds of thousands of pounds have been squandered on varieties of projectiles,* each variety devised to meet these impossible conditions. Gunpowder manufacturers have exhausted ingenuity to the same purpose. And what is the result? Simply that an "increasing spiral" causes oscillations of pressure from 20 to 66 tons on the square inch under identical conditions, both in an 18-ton and in a 35-ton gun; and that it has destroyed the latter in 38 horizontal discharges after most careful nursing. Is this the result that the increasing spiral was intended to produce?

* Up to last July, 770,282 projectiles had been studded. At the estimated cost of £77 per thousand, the expenditure on *studding* alone was £59,311. Many thousands of these projectiles have been destroyed, either in store or after having been fired.

At least six heavy guns, rifled with increasing spirals, have been disabled during the past year. Yet 1872 was a year of profound peace. Not a single gun was subjected, during that year, to anything in any way approaching to the ordinary conditions of a naval action. The Practice Tables of the late 35-ton gun show that pressures rise as bores get roughened by repeated discharges. If 32 discharges each, scattered over the whole year, have disabled six heavy guns in 1872, will these guessers and calculators tell us how many hours of elevated fire a worn 35-ton gun would endure at the rate of 20 rounds per hour?

Ships of war are but floating gun-carriages. The most recent ones cost about £100,000 per gun. If these weapons won't endure an ordinary naval action, is it worth while building floating carriages for them? All the intelligence of the Navy protests against being sent to do battle against "foemen worthy of their steel," with weapons that yield the minimum of perforating power, and won't even withstand combats against canvas targets.

If our guns are no longer to have "decidedly the lowest velocities," and decidedly the least perforation; if they are to employ the largest powder-charges which their several bores will burn; if they are to yield an endurance proportionate to their weight and admirable build; and if the powder-pressures are to follow regularly the apparent conditions of the powder-charges employed, every well-informed mechanician believes that we must:—

1. Give the shot the longest possible rifle-bearing in each groove.
2. Adopt cast-iron radial bearings which won't shear or wedge, and will strengthen the projectile.
3. Centre the axes of the shot and the bore during exit, on that plan which gives the greatest windage for loading foul guns.
4. Proportion the twist to the length of the projectile, rather than the converse.

This done, we shall hear no more of unaccountable "wave pressures;" of melting up all recovered projectiles; of Ordnance Inspectors to report, after every 50 discharges, upon injured bores and disabled guns; and I shall be able to return into private life, conscious that I have not dishonoured the Naval Profession by forgetting that, at whatever personal hazard, "England expects that every man shall do his duty."

The CHAIRMAN: Before I convey the thanks of this meeting to Commander Dawson and express to him the satisfaction we have had in hearing such an elaborate paper, and our sense of the enormous amount of research which it must have cost him to prepare that paper for your notice, perhaps some gentleman would like to offer some remarks upon this subject.

Admiral HALSTED: I fully agree with the main points of Commander Dawson's paper. I merely want to say this: Commander Dawson says he has consulted in every direction; but it is very curious that he has omitted to mention one of the most eminent practical mechanicians existing in the world—I mean Sir Joseph Whitworth. Is he already dead and buried? This very question of self-centering rifled projectiles is the original deduction of Sir Joseph Whitworth, obtained from his small-arms shooting gallery of 1857, out of which experience, step by step, have grown the identical rifling of his two 7-inch and two 9-inch guns which we now possess. Then the question of shells has not been touched. Sir Joseph Whitworth is again the only person who can produce a steel armour-shell of five calibres, containing, as Commander Dawson told us, in Sir Joseph's own proposal for his 12-inch rifle, 58 lbs.

of bursting powder, and being upwards of 1,200 lbs. in weight, the same weight as in the proposed Woolwich 45-ton gun. Let me mention this subject again with direct reference to the two 9-inch Whitworth guns which we have now got. What, I ask, is the normal bursting charge of their $3\frac{1}{2}$ calibres armour-shells ? It is 15 lbs., and here we have the 35-ton Woolwich gun only capable of giving us about $8\frac{1}{2}$ lbs. But, then, what again is the bursting charge of Sir Joseph Whitworth's 5-calibre 9-inch armour-shell of the same gun? It is 25 lbs. Now, of two 2-turret ships with equal thickness of armour-plating: put two 35-ton guns into the turrets of the one ship, such as are those of the "Devastation" at this moment, and let those guns attack the couple of turrets in the other 2-turret ship armed with Whitworth's 9-inch guns of only 15 tons weight. Let there be equal penetration upon both sides, and who can doubt what must be the result of exchanging shot for shot between an armour-shell carrying a bursting charge of 25 lbs., and another armour-shell carrying a bursting charge of only $8\frac{1}{2}$ lbs.? How long is this going to last? Shell fire is the question of questions with regard to armour-plate artillery. It is not cold shot that we want, but shells. You may go on fighting with cold shot between well-designed ironclads of iron as long as you please. I will defy all the cold shot that shall be produced, say on the French side on the one part, and all that we can produce at Woolwich on the other, to make a hole some 10 or 15 feet under the water line 5 feet long and 4 feet wide, as in the recent case of the "Northumberland," and even when that shall have been done, you only get a couple of water-tight side compartments filled with water, and the ship sails away from Madeira to Gibraltar almost as if she had received a mere flea-bite. And when she gets to Gibraltar she does not go into a dock, but is only careened sufficiently to get a coffer dam over her side, and in less than a week the whole injury is repaired. That is the present state of our well-designed ironclads of iron; they are practically unsinkable by any cold shot you can fire at them. What cold shot could be fired equal in effect to the prow of the "Hercules?" What we want, if we are really to destroy each other in ironclad war, is not cold shot, but the most destructive shell, and you must have a gun able to deliver it; and if you can get guns capable of delivering 5-calibre armour-shells they will have the advantage over those which are only capable of delivering with safety 3-calibre shells. As I say, if only on this all-important question of "shell-fire," this Woolwich system ought never to have been adopted.

Captain Jasper Selwyn, R.N.: I wish to draw attention to the fact that hitherto we have not exactly discussed the paper. The question is not so much what is the best gun—we shall get at that by and by, but how to use best and not misuse the guns we have. I so thoroughly go with Commander Dawson in most of his paper, that I shall only note one point of difference in the explanation of the way in which an elastic gas acts on the base of a shot. It is not quite sufficient to consider that the gas will not pass as well underneath the shot as above, though it is perfectly and absolutely true that while the shot reposes on the bottom of the bore, as it must necessarily do with this system, there is a greater space above the shot than below, and therefore a greater rush of gas through the upper part than below, and that that will produce the tilting which Commander Dawson has described, yet we shall be open to the remarks of others who go into this question of powder waves if we fail to show that we understand that the elastic fluid passes in every direction and exerts in every direction the same pressure at the same time. Captain Scott, whose system deserves our closest investigation, foresaw that the shot must be centred: he was the first within my recollection to talk of the centering of a shot; he was the first to show us how we could do so by long bearings, by carefully brought-out inclines with those bearings, so that the shot once started into motion, would have no other tendency than to support itself evenly from point to base in the true axis of the bore, and that under these considerations, no wriggling, as Commander Dawson prefers to call it, could take place, and the shot would pursue its even path with the pressure behind it due to the increments of pressure coming either from pebble powder more slowly, or from fine grain powder more quickly. I entirely concur with Commander Dawson in everything he has said as to the utter nonsense of talking about waves of gas being excited by any other cause than suddenly increased pressures due to obstacles. Powder gas like all other gases does never increase sud-

denly in force unless it encounters such obstacles. That the guns hitherto made have not been made with different forms of rifling, I regard as a subject for the greatest regret. The guns which we might in future try, though they may not require to be either re-rifled or re-lined and re-made in the extraordinary way which Commander Dawson has spoken of, might be tried at no great expense to the country with different kinds of shot. I do not think that while we have such results as these, it is wise to ignore the fact that with the long bearing, however made, we have never yet had any destruction either of the shot or the gun. Let us try whether in those guns, without the increased spiral, which we know only last a certain number of rounds under present circumstances, the introduction of different shot will stop that destruction and enable us to trust to our guns for a greater number of rounds. I may state that there is a remarkable difference between the shot exhibited as Captain Scott's and that exhibited as Mr. Vavasseur's, and it consists in the fact that if you take a cylindrical body of iron and cut pieces out of it whether in the form of stud holes or long grooves, you weaken that body; but that where you get long bearings cast on the shot you have two advantages—you do materially strengthen either shot or shell in certain lines, and you do also prevent those shot, if they are being knocked about and receive the damage due to careless handling, from being so likely to ruin your guns, though constructed on the best principles. I think the weight of this Institution, if it is brought to bear in any direction, ought to be given to the advocacy of more extended, more careful, more close experiments than have yet been made with more natures of shot. What we shall do with the guns afterwards in the way of getting rid of an idea of increasing spirals I won't say. If we consider the shot as issuing from the bore with a gradually increasing velocity, we shall see that even an even-spiral gives an increasing twist or speed of rotation in so many parts of a second to the shot in proportion as the speed of the issuing shot is itself increasing. It will do so very injuriously if at any point by reason of the bearings being short bearings, there be a wriggling of the shot in the bore, and where the spiral increases in the gun, with an even spirality of studs on the shot, as Commander Dawson has beautifully described it, you have to find out at which point to make your compromise between the two spirals. He has said, I think with perfect truth, that the increasing-spiral is the reason for the affection which exists at Woolwich for the studs; we cannot have a long bearing which we should like, simply because we have the increasing spiral. The increasing spiral again rests on theory, and has not succeeded in practice; the opposite is just the condition of the long bearing and even-spiral; it has not been advocated much in theory, but it has proved itself in practice. Now, as I have always been of opinion that an ounce of theory is a very good mixture with a pound of practice, I hope we shall have in future a little less of the first, and a little more of the second in this case.

The Chairman: I will, with your permission, return the thanks of this assembly to Commander Dawson for the very able paper which he has read to us.

There not having been time for Captain Dawson to reply to the remarks made in the discussion, he wishes the following note to be added:—

Note.—Commander Dawson wished to express his thanks to those gentlemen who took part in the discussion, and, with reference to some observations made, to point out that the whole of the erosion or roughness caused by the escaping gases about the seat of the projectile was in the upper part of the bore, and none whatever below the shot. In those rare instances in which roughness or erosion from the gases was found in the lower side of the bore, it never extended inwards to the seat of the base of the shot. The reason of this appeared to be that the fouling matter from former discharges filled the spaces below the shot in its seat, and that nearly all the windage was above the seat, the upper grooves being only very partially occupied, whilst the initial stages of combustion took place on the upper side of the cartridge, and the first gases evolved naturally rose in the bore, and strove to escape through the wide grooves and open space above the shot. The initial movements of the shot were influenced by this initial stage of the process of combustion; but, no doubt, when this less-than-momentary stage was passed, the shot would be enveloped in the gases, as was noticed in some Woolwich-rifled

guns by a slight degree of roughness in the lower side of the bore outside the seat of the shot. The "oblique movements of the axis of the projectile" about its studs were, however, initiated vertically and horizontally before the shot had moved more than eight inches forward.

If we suppose that the shot, balanced in unstable equilibrium upon two studs, was surrounded by equal pressures of gas before it began to move, then the forces we should have to deal with would be simply those of a pressure against the base, and the resistance of friction and gravity acting through the lower rear-stud. The resultant of those two forces would be represented by a line from the lower edge of the base to a central point above the rear-stud. This resultant of forces would operate so as to throw the base up, and the point down, causing the front stud to hammer downwards in its seat instead of upwards; but still equally causing the vertical "oblique movement of the axis" referred to by the learned Professor of Artillery. We should in that case look for the "cracks," "fissures," "dents," "local enlargements," and other damages near the seat, in the lower side of the bore, and not in the upper. Now, as a matter of fact, in the late 35-ton gun, only two "cracks" are found "down," and all the other injuries are "up;" whilst one of these two "cracks" being *on the edge of the lower groove* would appear to have been due to the rear-stud coming into bearing, and not to the front studs hammering; the other crack "down" is in the *centre* of the groove, and might properly be ascribed to the front stud. On the other hand, the other *edge of a groove* found cracked is "up," showing that the shot *jumps* and does not act uniformly in the lower side of the barrel in accordance with the laws of gravitation. Moreover, it is generally found that when other "Woolwich" rifled guns are so eroded as to be obliged to be turned upside down and re-vented, the base of the shot partially obliterates the scoring at the seat, showing that at starting the base is thrown downwards and not upwards. It was a consideration of the marks found in the 35-ton and other "Woolwich" guns, which led me to reject the idea that the shot was enveloped on all sides in equal pressures of gas before starting, and to suppose that its initial movements were influenced by the initial stages of combustion. Speaking generally, I am inclined to regard the damages above the seat of projectiles as inflicted by the front studs, and those found below the seat, as the suicidal work of the rear-stud. Though invariably operating in the same longitudinal part of the bore, the vertical action of the studs is evidently erratic, as the position of some of the cracks and fissures in Woolwich-rifled guns, occasionally tally with that explanation which I have thought fit to reject, but which Captain Selwyn thinks most correct. The distinction between the two vertical actions, viz., of the gases acting above the base in its seat, and of their equally enveloping the shot before starting, is on scientific grounds worthy of careful investigation; but as to the practical question, Captain Selwyn and I are quite agreed that the 35-ton gun was disabled by the action of the front and rear-studs, within a few inches of their seat in the bore; and that the high and erratic powder pressures registered $3\frac{1}{2}$ to 4 feet off, at the inner end of the barrel, were the natural result of the "oblique movement of the axis of the projectile" about its studs at the point where these injuries are found; and that such "wriggling" would increase in force, offering a greater obstacle to escape, in proportion as the "roughnesses," "cracks," "fissures," "enlargements" and "burrs" enhanced the friction upon the rear-studs; and that such increased severity of "wriggle" would lead to still further irregularity in the powder pressures.

LECTURE.

Friday, January 31st, 1873.

Colonel SIR GARNET J. WOLSELEY, C.B., K.C.M.G.,
Assistant Adjutant-General, in the Chair.

MARCHES.

By Major G. Pomeroy Colley, 2nd Queen's, Professor of Military Administration and Law, Staff College, Sandhurst.

When I undertook to deliver a lecture at this Institution on the "March of an Army," I felt the difficulty which must occur to most who speak here. I knew I should probably be addressing many Officers of much more practical experience in the subject than I could pretend to, and that I was to be honoured with the presence in the Chair of an Officer who himself planned and successfully carried out one of the most brilliant expeditions in our annals. But I thought that this subject, the "Science of Marches," especially as applied to the movement of large masses under modern conditions of war, hardly received the full attention it merits, and hoped that my few remarks, however imperfect, might lead others to carry the subject further, and give us the benefit of their practical knowledge.

We commonly class operations of war under two broad heads—Strategy and Tactics. But there is a third intermediate branch, recognized more generally a little time ago than it is now, namely, "logistique," or the science of marches. The first—strategy, deals with the great conceptions which govern the plan of campaign; the second, "logistique," with the scientific combination of marches, the calculations of time and distance, and of economy of men's powers, by which the strategical conception is worked out to the desired consummation; and, finally, "tactics" step in to reap the fruits of these combinations. Their relative importance may fairly be placed in the same order. Strategy stands highest by universal consent, but the second place is commonly assigned to tactics. Yet many campaigns are decided almost without fighting. Our three most recent and successful expeditions were essentially marches. The Ulm campaign was won by marching, and no tactical skill could have altered the result. It was not so much to his own superior strategy, or to the faults of his adversary that Napoleon was indebted for his brilliant success, as

to the astonishing rapidity of the march across France. If the Russian armies had marched as quickly to the assistance of their allies as the French did against them, the campaign would have been fought out under very different conditions.

It is true that railways have to some extent superseded marches, and that the first result of the campaign will usually be decided by pure strategy and superior organization, rather than by logistique. But even in the last war, many operations turned simply on marching power. Thus in the operations before Sedan, if MacMahon's forces could have marched as rapidly as those of the Crown Prince, the immediate object of the movement—the relief of Metz, would doubtless have been attained. I say nothing of the ultimate results, which probably would not have been very much affected. We hardly realise how seldom tactics alone, independent of superior numbers, armament, or quality of troops, determine the result of a campaign. Even Napoleon's genius could rarely turn the tables on the battle-field when the numbers were against him. Lastly, the casualties of a march often far exceed those of a battle. I shall have occasion to refer to this in speaking of Napoleon's advance into Russia. And, therefore, from the point of view of economy of life, the march requires as careful study as the battle.

There is certainly no lack of interest in military matters among us at the present moment. Questions of all kinds are freely discussed, not only in professional publications, but in all the most influential newspapers. Works on strategy and tactics have recently appeared, that any army may be proud of. But it is to tactics that attention has been principally directed. It is natural that it should be so. The incidents of a battle have a stronger interest than the details of the weary marches that preceded it. Moreover, any Officer may bear an important part in bringing about a tactical result, while the organization of marches rests in the hands of a few. The Wellington essays and others treat fully of what may be termed the tactics of marches; but very little has been written on their organization. Abroad, this is treated as a distinct subject. Important works are specially directed to it, such as the two from the pen of General Gallina, the Chief of the Austrian Staff. "Die Armee in Bewegung," and "Technik der Armee Leitung." It also forms an important part of their practical staff instruction. "Skeleton manœuvres" are carried out annually by staff and other Officers, at which all the necessary calculations of time and distance, the formation of columns and their distribution to the several roads, and the issue of all necessary orders, are worked out as they would be on active service. I may perhaps be allowed to mention here that this kind of practical instruction has been introduced for the last two years at our Staff College, and seems to work very satisfactorily.

But in all military questions in England, whether larger ones of national organization, or smaller ones of individual instruction, we labour under a difficulty which our critics hardly allow for—the varied nature of the duties expected of us. An English Officer's education has to be much broader than that of any foreigner. A German

learns certain lessons in tactics, marching, outpost duties, bivouacks, &c.; he practises these every year at peace manœuvres, and when he goes to war whether it is against France, or Austria, or Russia, it is all the same—he has only to apply them. An English Officer may have learnt these principles just as thoroughly; but the first war he is engaged in, is probably one of bush-fighting in New Zealand or Africa, or against fanatics in India, where all that he has learnt goes for very little. What forms the complete education of a foreign Officer is only a fraction of that of an English Officer. And so it is with the subject of my lecture. A lecture on "marches" addressed to English Officers, to be complete, should include bush-marches, Indian-marches, Abyssinian-marches, a hundred kinds of marches. But a dozen lectures would not suffice, even if one man could deal with so large a subject. I propose, therefore, to confine myself in this lecture to the marching of large bodies of troops in ordinary civilized countries—to such points as arise in a great European war.

All combinations of marches turn on accurate calculations of time, distance, and the marching power of men; and it is therefore necessary first to determine what distances can be traversed by troops within given times. All nations allow about the same average rate of marching, viz., $2\frac{3}{4}$ to 3 miles an hour for infantry,* 4 miles for field artillery, and 5 for cavalry and horse-artillery. This includes short halts of five minutes or so, and represents the pace at which they can get over fair marches with least fatigue. But these rates apply to small bodies only. With large bodies, the rate is slower, for every check is felt throughout the column, and multiplied by the length of it. Thus a division of infantry can seldom accomplish more than $2\frac{1}{4}$ to $2\frac{1}{2}$ miles an hour, and a corps on one road even less—2 miles an hour; the infantry, as the slowest marchers, regulating the rate of the whole. And even this rate can only be depended on on good roads and with good arrangements; if the roads are bad, or crowded, it is still further reduced. Thus Vandamme, marching from Ligny to Wavre, and the Prussians marching from Wavre to Waterloo, could only accomplish about $1\frac{1}{2}$ miles an hour, owing to the bad state of the roads. Napoleon's troops—trained marchers as they were—could sometimes only accomplish eight or nine miles in as many hours in the sands and mud of Poland. At Magenta, when support was urgently required for the Guard, it took five hours to bring up Canrobert's corps from Novarra, a distance of 9 miles. The road in this case was excellent, but encumbered. In 1866, before Sadowa, the 8th Austrian corps took 14 hours to do 12 miles. In 1870, when the Crown Prince was following MacMahon northwards, his troops were sometimes on their legs from four in the morning till eight at night; yet it is doubtful if they ever accomplished 24 miles in one day.

The average day's march is usually estimated at 12 to 15 miles, with a halt every fourth or fifth day. From 15 to 20 miles are long marches,

* The Italians, who devote special attention to the marching of their men, allow a somewhat higher rate. See "Istruzione per l'Ammaestramento Tattico delle Truppe di Fanteria," p. 161.

and are seldom kept up many days; and anything over 20 miles may be treated as a forced march. To a good walker, these distances may seem small; but it must be remembered they only represent a part of what is done by the soldier, who may have to go a mile or more off the road to his billet or camp, to patrol during the march, or go on outpost, and mount sentry after it, besides performing the numerous minor duties of a camp: in all cases he carries a heavy weight, and moves under conditions very different to those of the ordinary pedestrian.

To form an estimate of what troops may be expected to do in a long campaign, I have carefully gone through the records of the most celebrated marches of ancient and modern times, verifying them where practicable. The actual daily average has seldom exceeded 10 miles (including halts), or 14 for marching-days only. Of ancient marches that of Xenophon and the 10,000 Greeks is the best known, and perhaps the most remarkable. The march from Sardis to Cunaxa, near Babylon, was about 1,400 miles, and accomplished in five months' marching, or a little over 9 miles a day. The retreat to the Bosphorus was considerably longer owing to the detour made, and the rate slower, the Greeks being constantly harassed on the march. The total distance gone over, is estimated at about 3,500 miles, and took fifteen months, being about 8 miles a day.

Xenophon's experiences agree fairly well with our own. A good day's march under favourable circumstances seems to have been 16 to 18 miles. When in presence of the enemy and in fighting order, this was reduced to 10 or to 13 miles. Occasionally to cross deserts, &c., they did from 24 to 26 miles in the day; but a few such marches were always followed by a good rest.

Alexander's armies traversed greater distances, but his campaigns present no such long continuous marches. They were rather a series of eager advances or pursuits, and long halts. With his infantry, he seldom exceeded 14 miles a day for any length of time. He accomplished some wonderful feats in the pursuit of Darius, but in these cases his infantry fell behind, and he was generally left at the end with his cavalry only, and often very little of that.

Among modern marches, that of Napoleon's army, in 1805, from the shores of the Channel across France to the Rhine, and thence to Ulm, stands pre-eminent. There is no difficulty in verifying this march. We know the days of arrival and departure, and can measure the distances. Fezensac and other writers give many details of it; and through the kindness of the Baron de Grancey and the French War Office, I have been put in possession of the actual march-routes of some of the columns, showing each night's halting-place. The distances traversed by the several columns varied slightly, but averaged about 400 miles, to the Rhine; the time taken averaged 26 days. This gives between 15 and 16 miles a day, or, if allowance is made for halts, nearly 20 for every marching day. The three corps from the camps near Boulogne marched by distinct routes; each corps marching by divisions at one or two days' interval. The troops reached the Rhine punctually, and in perfect condition, with almost incredibly few casu-

alties, and immediately crossed and continued their march on the Danube.*

This was an exceptional feat, and stands alone; but Napoleon's movements generally were more rapid than those of his predecessors had been, and to that he owed much of his success. Marlborough's most celebrated march was that made in 1704, by which he transferred his army from the Netherlands to Bavaria, joined Prince Eugene, and won the battle of Blenheim. The distance continuously marched was 240 miles, done in 25 days, or a little under 10 miles a day. Frederick's movements were slower still; his best-known march is that from Rossbach after defeating the French there, to Leuthen, where he defeated the Austrians; but he averaged under 8 miles a day.

The best march in the last war was that of Prince Frederick Charles with the second army from Metz to Fontainebleau and Orleans. The average rate seems to have been 12 or 13 miles; but the 9th corps marched more rapidly, being hurried forward in consequence of the French advance. The last few days of its march, from Troyes to Fontainebleau, averaged as much as 19 miles. To do this march justice, it must be remembered that it was made in an enemy's country, infested with Franc-tireurs, was harassed by obstacles on the roads, and was sometimes seriously opposed.

By comparing a number of marches, I arrived at the conclusion that 10 miles a day is as much as should be reckoned on in prolonged operations, and from 12 to 15 miles for actual marching days; and these calculations agree curiously with the account of the operations of the 5th German Corps in the late war, just published. It appears the distance actually traversed by this Corps between the Rhine and Paris was 520 miles in 50 days, or $10\frac{1}{2}$ miles a day. The average for actual marching days was $13\frac{1}{2}$ miles, with a halt usually every fourth day; and the longest day's march was 21 miles, being made during the pursuit of MacMahon's army northwards.†

Forced marches, though often brilliant feats in themselves, have not the same practical value for strategic combinations. St. Cyr calls them the resource of an improvident General, but rarely used by a prudent one; and says their too frequent use soon destroys an army. Moreover, men's powers, in this respect, are much overrated, and few of the most celebrated marches will bear investigation. A single march is so easily exaggerated or misrepresented, even unintentionally. A body of troops marches, say at ten one morning, does 20 miles that day, has a full night's rest, and marching at four the next morning, reaches its destination, 15 miles distant, by ten. For all practical purposes this is merely doing 35 miles in two days' march. But a friendly historian, to make it sound better, says they accomplished 35 miles in twenty-four hours, and the next friendly historian, not observing the delicate distinction, says they

* Accounts of this and other marches of Napoleon's are given in Dumas', Thiers', and other general histories; but the most interesting details are to be found in personal narratives, such as those of Fezensac, Labaume, Dr. H. von Brandt, &c.

† "Das V. Armee-corps im Kriege gegen Frankreich," 1870–71. Stieler von Heydekampf.

did 24 miles in a day, and so it goes down to history as a remarkable forced march. I am sorry to say one of the first results of my investigations was to throw the gravest doubts on the celebrated march of the Light Brigade before Talavera, so familiar to students of Napier, and so frequently quoted to show what British troops can do. Napier's account of it is as follows:—

"That day (29th July, 1809, the day after battle of Talavera), "Robert Craufurd reached the camp with the 43rd, 52nd, and 95th "regiments, and immediately took charge of the outposts. Those "troops had been, after a march of 20 miles, hutted near Malpartida "de Plasencia, when the alarm caused by the Spanish fugitives spread "to that part. Craufurd, fearing for the army, allowed only a few "hours' rest, and then, withdrawing about 50 of the weakest from the "ranks, recommenced his march with a resolution not to halt till the "battle-field was reached. As the Brigade advanced, crowds of the "runaways were met with, not all Spaniards, but all propagating the "vilest falsehoods: 'The army was defeated,' 'Sir Arthur Wellesley "'was killed,' 'The French were only a few miles distant;' nay, some "blinded by their fears, pretended to point out the enemy's advanced "posts on the nearest hills. Indignant at this shameful scene, the "troops hastened, rather than slackened, their impetuous pace, and "leaving only 17 stragglers behind, in 26 hours crossed the field of "battle in a close and compact body, having in that time passed over "62 English miles in the hottest season of the year, each man carrying "from 50 to 60 lbs. weight upon his shoulders. Had the historian "Gibbon known of such a march, he would have spared his sneer "about the 'delicacy of modern soldiers.'"*

Now, there is an inconsistency even in Napier's account. The distance from Malpartida de Plasencia to Talavera is 62 miles; consequently, the actual distance marched would be 82 miles,—a still more wonderful feat. Through the kindness of a distinguished Peninsular Officer, himself present on the march and an experienced Staff Officer, I have been put in possession of what I believe to be the actual facts, which are as follow:—

The Light Brigade reached Malpartida on the 25th, three days before the battle. On the 26th and 27th they made two short marches, marching early in consequence of the heat of the weather. On the 28th they had completed their day's march early when they heard of the battle. Craufurd waited till the heat of the day was past, broke up in the evening, gave his men a halt during the night, and reached the battle-field about sunrise the next morning, the actual distance traversed from the halting-place on the night of the 27th being 40 miles. Finding the battle over, the brigade halted and rested; and in the afternoon crossed the battle-field and took up the line of outposts.

Sir William Napier did not himself take part in this march; he was taken ill a day or two before, and was taken back to hospital by his brother George, and it seems to have been the extraordinary march made by the latter to overtake and rejoin his brigade which the

* Napier, ii, 178.

historian confused with the march made by the brigade itself. The authorities by which the version I have given of the march are supported, are the following, viz., the notes and recollections of the Officer I have already referred to; journals of other Officers who, like himself, took part in the march; returns which are, or recently were, at the Horse Guards, showing that the Light Brigade was at Malpartida on the 25th, three days before the battle; and the statement of one writer, that he was with the Light Brigade in every march throughout the war, and can safely assert that neither they, nor any other troops he ever met with, could have made such a march.

The most extraordinary feat in ancient or modern history, if we can believe it, was the march made in the Second Punic War, by which the Carthaginian power in Italy was finally broken. The circumstances are familiar to most students of Military History, because it is the stock example quoted by writers on strategy to show that the true principles of strategy, and of interior lines, are as old as war itself, and were understood and applied by the ancients. The Consul Claudius Nero, with a Roman army, was facing Hannibal, who had taken up a position at Canusium, awaiting the arrival of his brother Hasdrubal, with the reinforcements he was bringing from Spain. The Consul Livius Salinator, with another Roman army, was opposed to Hasdrubal at Serra Gallica, near the Metaurus. Having intercepted all communications between the brothers, Claudius determined to try and crush Hasdrubal while isolated; he accordingly set out secretly from his camp, with 1,000 cavalry and 6,000 infantry, the *élite* of his army, leaving the rest to oppose Hannibal. In six days of forced marches he joined his brother Consul, with their united forces attacked Hasdrubal, utterly defeating and killing him, and immediately started south again, accomplishing the return journey in the same time and regaining his camp before Hannibal had discovered his absence. Now, the distance fairly measured, is 240 miles, or at the rate of 40 miles a day for six days, both going and returning; and making every allowance for the assistance said to have been derived by requisitioning carts and horses along the road, it is very hard to believe in such a march. It is a curious and instructive fact that the two ancient campaigns, of which we have most authentic accounts, Xenophon's march and Cæsar's Gallic wars, where the General himself is the historian, are those in which we hear least of extraordinary forced marches.

Hitherto I have spoken of movements of columns of all arms; of remarkable cavalry marches there are many authentic records. One of the best known is that of Charles XII from the Vistula to the Oder in pursuit of the Saxon Army, when he marched over 30 miles a day with all his cavalry for nine days consecutively. The distance is not exceptional, but it was done with a large force of cavalry, and over bad roads. But I believe that the records of our Indian wars, of Lord Lake's Mahratta campaigns, and, more recently, of some of the flying columns during the mutiny, contain the most remarkable examples of such feats. Unfortunately, from difficulty of finding the places on the map, and identifying names, it is often impossible to verify them.

The next point to be considered is the space occupied by troops on the march, as it is the length of the column which causes the difficulty in moving and feeding large bodies of troops. I need not trouble you with the calculations, which any one can make; but a good practical rule for a Staff Officer in the field is to allow a yard for every one horseman and for every two foot soldiers, and 20 yards for every gun or waggon. The difficulty is to know how much to allow for unavoidable opening out on the march. This is variously estimated by different writers at from 5 to 60 per cent., rather a serious margin of error.* Verdy du Vernois does not think it necessary to make any special allowance; while Colonel Lewal, a French Staff Officer, estimates it at two-thirds the proper length of the column, and quotes examples from the Italian war of 1859 in support. Perhaps the nationalities of the writers partly explain their difference of opinion. The Prussian troops close up on the march better than any troops I know: on the other hand, the French, though really excellent marchers, are notorious stragglers: their own Officers acknowledge and complain of this. A Prussian Staff Officer, to whom I showed Lewal's calculations, answered at once "He is probably right; but it does not say much for the discipline of his troops." Probably we shall be right if we take an intermediate estimate, and allow about 25 per cent. On this calculation an English infantry division on war establishment with its full train occupies about 12,000 yards. During the autumn manœuvres of 1871–72 I had several opportunities of measuring the length of columns of march, and found the above calculations fairly correct, exceps in the case of hired transport. I was much struck with the difference of length of a column of regimental transport as organized last year under experienced baggage masters, and the columns of hired transport of the year before.

The Austrians advocate considerable intervals between regiments and brigades, and there is much in favour of this system. If a regiment unavoidably opens out to the extent of one-third or one-fourth of its length, it seems better to allow the next regiment to start with a corresponding interval. The ultimate length of the column will not be increased, and the heads of regiments will be able to maintain a uniform pace as if marching independently, and avoid the constant checks and changes of pace so fatiguing in long columns.

The order in which the column of march is formed must necessarily depend on various considerations, such as the object of the march, the nature of the country, or the vicinity of the enemy. But two great principles should always be adhered to. The first is that when in presence of the enemy, everything must give way to tactical considerations; when at a distance, the ease and comfort of the men must be first considered. The second is that everything should be arranged in the column in the order in which it is likely to be wanted.

A column in presence of the enemy is always preceded by an advanced guard, whose duty it is to save the main body from surprise or from being made to fight under unfavourable circumstances. Consequently,

* See Wolseley's "Soldier's Pocket Book;" Verdy du Vernois "Studien über Truppen Führung;" Colonol Lewal "Conférence sur la Marche d'un Corps d'Armée."

as the range of weapons increases, and battles are fought at greater distances, so must the range cleared by the advanced guard be increased. In these days, if a battery of artillery is allowed to march along an ordinary enclosed road within 1,500 yards of the head of the advanced guard, it might be annihilated by an enemy's battery suddenly unmasked. The point of the advanced guard must be partially liable to surprises, and therefore is made small and mobile, cavalry being always chosen for this duty, if possible. This "point" is supported by somewhat stronger bodies at suitable intervals, but no large body of troops, and no wheeled vehicles (except perhaps a couple of guns without waggons, or a light cart with entrenching tools) should be allowed to come within effective artillery range of the head of the advanced guard, or of any point which has not been reached or overlooked by them or by the flankers. The detailed formation of the advanced guard is a tactical question which does not come within the scope of this lecture.

The main column follows, the artillery generally near the front, ready to perform its rôle of opening and preparing the battle. The bulk of the infantry follows, each regiment accompanied only by its ammunition carts and tool waggon. The cavalry, if not with the advanced guard, generally follows in rear of the infantry. The train then follows, arranged on the principle given—first, that which may be required during the action, the reserve ammunition and the ambulance detachment; then what will be most urgently supplied when the battle is over, the day's supplies; then the staff and regimental baggage; and, lastly, the reserve supplies and miscellaneous stores.

If no enemy is near, these arrangements may be modified to ease the men. The cavalry and artillery are separated from the infantry, as nothing is so fatiguing to the former as having to conform to the pace of the latter. If possible, they are given distinct roads, or allowed to march independently. When there is a choice of hours the mounted corps should move latest, as they take longest to prepare, and the horses do not feed so well at very early hours. The supplies and baggage may be brought more forward, and reserves of ammunition and field hospitals put further back.

It has been shown that a British infantry division on war establishment occupies about 12,000 yards, or seven miles, of which half is taken up by the combatants and half by the trains. This represents about $2\frac{1}{2}$ hours in time, that is, the column will take that time to pass any given point. Such a force can march in one column without any serious inconvenience or fatigue to the troops, or administrative difficulties. Napoleon's march to the Rhine in 1805 was by divisions, as was also a great deal of the marching in the late war. It is true the leading troops will have to wait at least an hour and a half for their baggage, but a certain time is necessarily spent in laying out the camp, collecting firewood, &c. If the troops have started at six and made a fifteen mile march—which, including a long halt, takes seven hours—they arrive between one and two, get their baggage between two and three, and are all settled by four. If the troops are marching in small bodies everything is still simpler.

But if even two divisions are marching on one road the inconvenience and delays become serious. The tail of the column will not be in till six, and the men will hardly get their dinners before dark, and if the weather is hot the second division will always suffer from marching during the worst hours, however early the first division starts. And if a whole corps has to use one road the difficulties and the fatigues are immensely increased. The tail cannot in any case be up till the middle of the night. If the divisions are followed by their baggage the last troops are not in by dark. If the baggage is massed in rear, the troops get in earlier, but are kept waiting many hours for their baggage and supplies. Nor is it exceptional for a whole corps to move on one road. It happened occasionally in the last war, though generally separate roads were found for each division. In 1859 the French had sometimes to march more than one corps on a single road, the number of good roads in Lombardy being limited, and the intervening country difficult to cross in consequence of the vineyards and ditches. In 1866, during Prince Frederick Charles's advance into Bohemia, he had at one time only two roads for four corps d'armée, and the difficulty of moving and feeding the troops under these circumstances is specially remarked on in the Prussian official account. In the invasion of Russia, Napoleon sometimes had to move 50,000 men on one road. The inconvenient hours of march, the long halts, the tedious delays, the irregular hours, the uncertainty of supplies, cause what the Germans term the "friction" which always attends the movement of very large bodies of troops. What the effects of that friction may be, we learn from Napoleon's invasion of Russia. From the Niemen to Smolensko is about 400 miles, the same as the march across France already quoted. The time occupied was 50 days, just twice as long. The troops had two long rests at Wilna and Vitepsk, and on actual marching days did not average more than 12 miles. The weather was hot, but not generally unfavourable, and the march was a triumphant advance almost without fighting. Yet the central column lost 90,000 men, solely from the fatigues and hardships and "friction" arising from crowding so many men on a limited number of roads.

The great object in arranging marches, therefore, should be to spread over as broad a front and occupy as many roads as possible consistent with safety; and where long columns must be sent on one road, to reduce this "friction" to a minimum by careful arrangements. In dealing with the first we have to decide what are the limits of safety. And here I must diverge into what is strictly a tactical question, but exercises a powerful influence on march-dispositions. Formerly it was generally accepted that when the armies were separated by at least a day's march it was sufficient if the whole force could be concentrated in a day, but that when collision was imminent, the marching front should not much exceed the fighting front. But I conceive that new tactical conditions, the increased retaining power of small bodies, and the increased value of flank as compared with front-attacks, have modified the latter rule, and that it should now be a maxim always to march on a considerably broader front than would be occupied in fighting. Thus if a corps of 20,000 men marching in a single column came

in collision with a corps of the same strength marching in three small columns separated by distances of six or seven miles, under former conditions the latter would probably be defeated in detail. The central column would find itself engaged with very superior forces; if it fights in a compact formation its flanks would be turned; if it extends to save its flanks, its centre could be pierced by superior weight, in either case probably before the adjoining columns could render effective assistance. But under present conditions, the central column could afford to extend to a much greater distance to guard its flanks; any attempt to pierce the centre by superior weight would be uncertain, and could only be attempted after long fire-preparation, during which time the flank columns would be closing in; and when these do come into action they do so in the most effective manner, namely, on the flanks of the adversary, who, in all his attempts to deploy, finds himself already outflanked, and in somewhat the position the French found themselves in on their sorties from Metz and Paris.

But it will still happen that long columns have to move on single roads, and that special arrangements become necessary to reduce the consequent discomfort and fatigues. Something may be done by marching the column on a broader front; but few roads admit of this. The cavalry may sometimes be sent across the fields; and in Bohemia and France, where there are few fences, the infantry often marched alongside the road, leaving the road clear for guns and carriages of all sorts. In enclosed countries bye-roads or lanes may be turned to account; such usually exist between the more important roads allotted to the several columns. But they are subject to several drawbacks. They are generally zigzag, consequently longer, and troops are more likely to go astray on them. There is always the risk of two neighbouring columns trying to use the same, and so coming into collision; the general or superior staff indicates the main line to be followed by each column, but cannot define how every little lane is to be used. It introduces, moreover, a dangerous element of uncertainty in time; on a good road calculations of time may be made with tolerable certainty, independent of the weather; but on bye-roads and lanes an unexpected fall of rain may upset all calculations.

Columns of more than one division are therefore generally made to march in echelons, or "staffeln," as the Germans call it; that is broken up into distinct bodies, moving to a certain extent independently. A division occupies seven miles of road. If a second division, following it, instead of closing up each night on the head of the first division, halts at a distance of seven miles in rear, the two divisions will form a continuous column on the march, but will be able to start simultaneously, reach their camping grounds at the same hour, get their baggage up at once, and in all respects work as independent columns. This system at once meets most of the objections to moving many troops on one road, and is that commonly adopted when not in presence of the enemy. But when close to the enemy, the extension is too great. If an English Army corps, with its three divisions of infantry, and corps artillery and cavalry equivalent to a fourth, is moving in this order on one road, the distance from the first to the fourth encampment will be 21 miles; and

if the leading column is attacked on the march, the rear ones could not close on it in the day. To obviate this, "reduced," or "half" intervals are used; that is the several divisions halt at distances equal to half the length of their column of march, or $3\frac{1}{2}$ miles apart. This is, in fact, a compromise; the troops do not move with the same freedom and comfort; the second division must start an hour or more after the first, or it would run into the tail of its column, and the other bodies must delay their march still further, and reach their camping grounds proportionately later. On the other hand the distance between the first and fourth camp is only $10\frac{1}{2}$ miles, and the corps can always be concentrated in the day.

There is another system mentioned by General Gallina, the Austrian chief of the staff, and which I believe was sometimes adopted in Italy, being specially applicable to cases where the climate makes it necessary to avoid the hottest hours of the day, and yet large bodies have to be moved in concentrated order. It is to marching by *alternate* echelons. The four bodies having encamped at half intervals, 1 and 3 move at a very early hour and simultaneously, 3 passing through the camp of 2, and reach their destination before the full heat. 2 and 4 march in the afternoon, and reach their camps late, regaining their original relative position. This method may also be adopted in passing a short defile, or when two parallel columns have to use one road for a time.

*Supply on the March.**

Any notice of marches must be very incomplete if it does not include the feeding of troops on the march, as it is this which often really governs the march-dispositions. The supplies carried by an army may be classed under three heads:—Those carried by the soldier, or regimentally, and which are always at his hand; those carried in the divisional provision columns, and the reserve supplies or field magazines which follow in rear of the Army.

The Prussian soldier carries constantly three days' reserve rations, "*eiserne* portion," as it is called, as part of his kit in his knapsack, consisting of biscuit, rice, and bacon. Besides this he carries common rations according to circumstances; usually one day's, but often more. The Austrians carry two days' reserve, and two days' ordinary rations; the Russians, four days' bread or biscuit; the French, generally three to six days' biscuit. We have no regulations on the subject. The question was raised during the autumn manœuvres, and some say that the British soldier cannot be made to carry his rations, that it is contrary to his habits and prejudices, and that we can only accept the fact, and carry them for him. I fear in any great European war he would have to overcome this prejudice or starve. In our distant expeditions, where the fighting columns are comparatively small, and the enemy not so formidable, the distance between the men and their supplies need not be great. But in European wars, when large armies are moving concentrated, and in presence of a powerful enemy, it is different. Every account I have been able to collect, whether of our own

* See Obauer and Gultenburg's "Train und Verpflegs-wesen."

Peninsular experiences, or of more recent European wars, agrees in stating that in presence of the enemy the day's supplies can never be brought up till late, often barely in time for distribution before the troops start the next morning. In the German war the troops on the march lived mainly on the inhabitants; but when concentrated for battle they depended entirely on the rations carried by the men, which could only be irregularly replenished from the provision column.* It has been proposed to attach a special cart to each battalion for the purpose, as was done at the last manœuvres, and as the Austrians are also doing. This has much to recommend it; but it must also be remembered that every additional waggon seriously hampers the fighting column, and in the urgency of battle it would often be pushed aside and unable to regain the battalion. The Prussians and Austrians have canteen or suttler's waggons, "marketender wagen," to each battalion, and generally allow them to accompany the battalion. The canteen man is a professional forager, who understands his business, and has nothing else to do, and manages to pick up supplies in a wonderful way when others fail. The Prussians would often have been in a bad way but for their canteens. Still these cannot be trusted to; and it may be laid down that the soldier is never safe, and the Army cannot be depended upon for any sudden operation unless the men always carry at least one day's rations.

The second line of supplies is that carried in the divisional provision-columns. In all continental armies there is a regular service organized for the purpose, of *military* transport, sufficient to carry four days' supplies. We have no such organization at present. In Prussia they are termed "proviant colonnen": they form part of the corps organization, but are usually attached to the divisions, two to each. In Austria, they are formed partly of divisional transport, partly of regimental waggons, which are worked divisionally, but usually supply their own regiments. They seem to have found that waggons which belong to particular regiments are more careful to find them out and supply them than if they had no such connection. In Russia they are formed of waggons which are kept in regimental charge in peace time, but are massed and formed into divisional columns in war.

The task of these columns is to replenish the regimental supplies; every day at the close of the march, if practicable, but often it cannot be done till late at night, or only on alternate days. When the length of column is considerable, the provision-columns have to make long forced marches, after the others have done, to reach the head of the column, and this often can only be done at night, when the troops are camped and the roads clear. Practically, a great deal of the supply duties are carried on at night, and hence the importance of always keeping the roads clear at that time.

The difficulty of feeding an army lies not so much in procuring supplies as in bringing them to the men. Napoleon had collected ample supplies for his invasion of Russia, yet his troops were nearly

* Some of the recently published histories of the last war give the particular occasions on which the troops were obliged to use their reserve rations. See "Das V Armée Corps," &c.

starving from the very beginning, and this was the primary cause of the immense losses I have spoken of. His cavalry at the head of the column swept the country, and to a great extent lived on it. The rear divisions were supplied without much difficulty from the provision trains. But the leading and central divisions in those enormous columns could neither live on the country nor be reached, except irregularly, by the provision trains from the rear; and theirs was consequently the heaviest loss in stragglers. When large columns are supplied entirely from the rear a halt every fourth or fifth day becomes necessary, not only for the men's sakes, but on Control grounds, to enable the provision columns to refill and the system of supply to be reorganized. A day of battle, or of concentration for battle, is also used for the same purpose.

The second line, or divisional columns, are replenished sometimes directly by requisition, purchase, or from the country, but commonly from the third line or reserve stores. The organization of these, which are also sometimes called field-magazines, varies endlessly, according to circumstances; but they usually consist of hired or requisitioned transport. If, as in late wars, railway-transport can usually be maintained within a day or two of the front a small reserve train suffices; but where armies are operating at a distance from magazines and railways it increases to an enormous extent. These again in their turn are refilled from the great magazines, directly or by means of railways, or by requisition on the country. It is a first principle of supply to draw everything that can be drawn from the country the troops are traversing by free purchase, forced sale, or requisition, and treat the magazines and provision trains as reserves only to be touched in case of necessity. However poor the country, it can generally feed a portion of the army; and if it can only supply the advanced guard or the leading division, a great deal has been gained, for these are precisely the most difficult to supply from the rear.

And now I come to the last branch of my subject, the preparation and issue of the orders for the march. The success of a march must necessarily depend on the care and precision with which the orders are framed. The great principles to be attended to are that the orders shall be clear and concise; that they shall convey such information as will enable subordinate commanders to execute them intelligently, not as mere machines; that they shall define minutely all points where collision between independent authorities might occur, and avoid interfering with details which lie entirely within the province of subordinate commanders.

I can illustrate my meaning very well by a reference to the orders issued to the 3rd, and Meuse Armies after Sedan. The movement on Sedan had been a continuous wheel by which the Army of the Crown Prince, originally on the extreme left, found itself on the west, and consequently on the right in any further movement on Paris. It was considered necessary to correct this inversion in the advance. The first part of the order explains the reasons for a somewhat complicated movement; the second lays down definite instructions where the two

armies might come into collision, but leaves everything within their own sphere of operation absolutely at the discretion of the Army Commanders.*

As models of orders I would quote those of the Archduke Albrecht for the Custozza campaign. They have a special interest, both on account of the brilliant success which attended their execution, and because their author was also the author of that remarkable work on "Responsibility in War," which lays down more clearly and ably than had ever been done before, the true principles of command. They are long, because they deal with complicated operations and many independent commands; but they never trench on the province of subordinate commanders, and they contain in themselves the whole history of the campaign.†

The Prussians have introduced a method into their orders which may seem almost pedantic, but has great advantages. All their orders are framed on the same model. They generally open with a brief statement of the object of the march, and any information about the enemy or the adjoining columns that will be useful. Then comes the hour, direction, and order of march of the column or columns, usually beginning with the advanced guard; their instructions for any flanking parties or detachments; next the orders for field hospitals, reserve ammunition, and fighting train generally; then those for the baggage and supplies; and lastly, the position of the General, or head-quarters. In this manner one knows where to look at once for any required information.

Thus the orders for the 8th Corps, before the battle of St. Quentin (January 15, 1871), run as follows:—

"According to reports received, the enemy has concentrated con-" siderable forces at St. Quentin, and pushed his outposts towards " Péronne and Ham. I order as follows for to-morrow:

"1. The 15th Infantry Division will march at 8 A.M. by Jertry to " Etreillers and its vicinity, sending out patrols at daylight along this " road, and in the direction of Vermand."

Paragraphs 2, 3, and 4 similarly give instructions for the 16th and reserve divisions and a detachment under Count Gœben. Paragraph 5 contains the orders for the corps artillery; 6, those for the train; and 7 lays down where the General will be found.

The orders issued by Prince Frederick Charles in the advance into Bohemia in 1866 open with full statements of what is known or supposed of the enemy's movements.

This system of explaining the reasons for a movement, of taking subordinates into confidence as it were, which we observe in the Prussian orders, is not I believe usual with us. There is an incident in the retreat from Burgos in 1812, which is related by Napier, and has always seemed to me very suggestive in this respect. It is thus told:—

* See Blume's "Operations of the German Armies in France."

† These orders are given at length in the Austrian official account, "Österreich's Kämpfe im Jahre 1866."

"Knowing the direct road was impassable, he (Wellington) ordered "the movement by another road, longer, and apparently, more difficult. This seemed so extraordinary to some General Officers, that "after consulting together they deemed their Commander unfit to "conduct the Army, and led their troops by what appeared to them "the fittest line of retreat. He had before daylight placed himself at "an important point on his own road, and waited impatiently for the "arrival of the leading division until dawn; then suspecting what had "happened, he galloped to the other road and found the would-be "Commanders stopped by the water. The insubordination and the "danger to the Army were alike glaring, yet the practical rebuke was "so severe and well-timed, the humiliation so complete and so deeply "felt, that with one proud sarcastic observation, indicating contempt "more than anger, he led back the troops and drew off all his forces "safely."

Fortunately, as it happened, Soult had just suspended the pursuit, and the army escaped what might have been a great disaster. Now there is nothing to be said for the Generals. No comments can be too severe on their insubordination. But it does occur to one that if the orders had been framed on the principles of those I have been quoting from, if it had simply been stated that in consequence of the main road being impassable, the troops would follow another route, the occasion never would have arisen. It is not too much to say that one-half of the cases of misconception or disobedience of orders, arises from want of sufficient confidence in subordinates.

The more we see of the Prussian orders during the late war, the more clearly two principles stand out—perfect confidence between the commander and his subordinates, and non-interference. In urging the principle of non-interference, I know that the example of the two greatest Commanders of modern times can be quoted on the other side. Both Wellington and Napoleon interfered, and constantly interfered in the details of their subordinate commands. But such men are no rule for others. A great genius fashions the tools for his purpose, and uses them well; but they do not work in other hands. It seems to be one of those mysterious laws of Providence, one of those compensating principles, by which the balance of the world is maintained, that the very genius which gives a nation its military pre-eminence in one generation, sows the seed of its decay in a future one. An army which has learnt to draw its whole breath of life from one man soon collapses when he is removed. It is with an army as with a regiment; the true test of its efficiency is that it shall work well under an indifferent commander; and this can only be the case when every subordinate has been trained to full responsibility and independence of thought and action within the necessary limits in his own special sphere. Such a system was forced on Prussia by the disasters of 1806, when the magnificent army created by Frederick the Great, but lifeless without his spirit to animate it, fell to pieces at the first touch. Such a system was urged on Austria after the disasters of 1866 by the Archduke Albrecht; and such a system—fortunately without the warning of disaster—is now being ably and earnestly advocated by many in England. No nation

has so much to gain by it as we have. No race can claim more natural independence and vigour of mind—witness our Colonies, our Indian career, the history of British enterprise all over the world—while our institutions have trained us to combine freedom of thought and action, with subordination to authority. If we can only learn to do justice to our special national characteristics, the stubborn courage of our men, and the independent self-reliant energy of our Officers, assuredly we need not fear comparison with any Army in the world.

SUGGESTIONS FOR A SHELTER TENT.

Contributed by Captain Tulloch, 69th Regiment, Garrison Instructor, Halifax, Nova Scotia.

With reference to the sheltering of troops during active operations, there may be said to be two distinct methods, viz., the English and the French. In the English service, the tents are carried for the men; in the French, the men carry them themselves; whilst the Prussians get what shelter they can without tents at all. There can be no doubt but that the English system is the best as regards the preservation of the men's health, and consequently their efficiency; but, judging from the experiences of the armies during the late campaigns, it would seem more than probable that if an English force be ever engaged in active operations on the Continent, it will frequently—no matter how perfect the transport may be—have to forego the use of bell tents, and be obliged to adopt either the Prussian or the French system. As regards the latter, although it is unquestionably convenient, in that it releases for other purposes a considerable amount of transport, which would otherwise be employed in carrying tents, yet it has several decided objections, the first arising from the circumstance that French soldiers have no other protection from the weather during a whole campaign than that of the makeshift nature obtained from *tentes d'abri*. The second objection is the weight of material which has to be carried by the men. (In our service the regulation *tente d'abri*, when dry, weighs about 12 lbs., that is, 6 lbs. for each man, the material not being divisible into three.)

With reference to the Prussian method, if the weather be fine, bivouacing is by no means so unpleasant as is generally supposed; but if the weather be wet or cold, it is a very different matter; and although the excitement of expecting to meet the enemy may keep off sickness for a time, yet the effect of even a few days' bivouacing in bad weather will tell very severely on the men, and rapidly fill the hospitals. Prussian Officers who served in the Austrian war of 1866 have informed me that the sickness at the close of the campaign was quite appalling, far exceeding what was generally known; they attributed it almost entirely to the maladies consequent upon having no shelter during a

continuance of very wet weather. The immense percentage allowed by the Prussians in calculating the probable number of casualties for a year's campaigning (in which the fire of the enemy is debited with but a small amount), is, I think, a sufficient indication of the waste of life resulting from their system.

If, then, the continental methods above named are so objectionable, what course suggests itself? Certainly there are drawbacks to every scheme, but, all things considered, I think that a very simple plan of giving men cover when away from their tents is possible, by a slight alteration of, and addition to, the waterproof sheets now carried with the tent equipage. These regulation sheets are 6 feet 6 inches by 3 feet, and have each six eyelet holes. By the substitution of six metal studs and six stud holes, and the addition of a divided stick, three small pegs, and two pieces of string, waterproof lean-to's may be erected, which will fairly protect those using them from wet or cold wind.

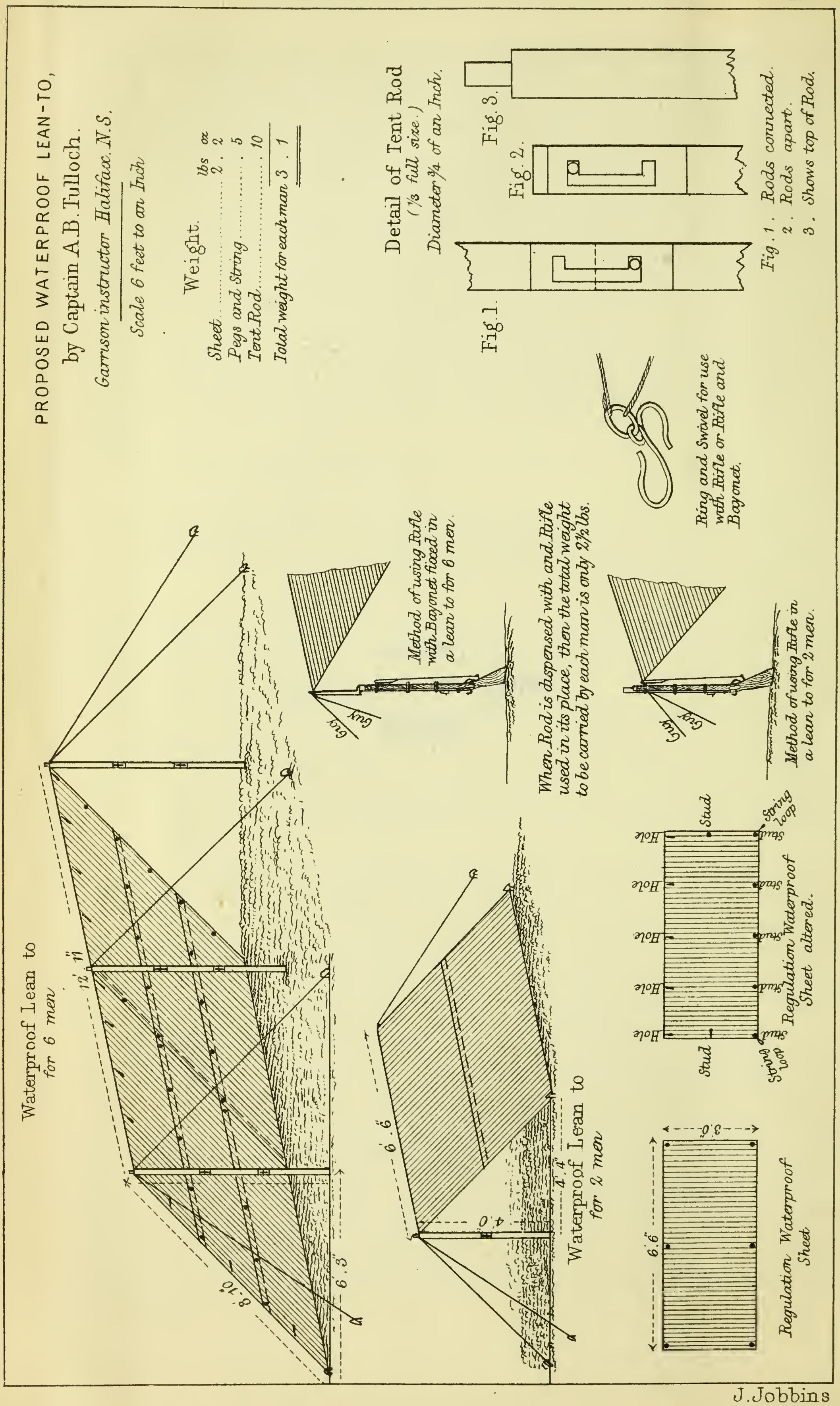
The weight is as follows:—

	lb.	oz.
Waterproof sheet..................................	2	2
3 pegs, 2 pieces of string 9 feet (cod line)	0	5
Divided stick (hickory) $\frac{3}{4}$ inch diameter, 4 feet long..	0	10
	3	1

The studs are intended to button on the under side, giving a lap over of an inch; the upper end of the studs (with the exception of the one at the side) to be covered with a small patch of waterproof. The stud holes at the right and left corners should be larger than the others, to receive the small end of the stick. The thin sheet-iron joint of the stick is to be arranged like the sliding measure on the top of a powder flask, so that when not in use, it may slip back on the stick, where it will be held by the little projection; the metal joint will thus be safe from injury.

The accompanying diagram shows the method of buttoning the sheets together so as to form cover for two, or any greater number of men. By buttoning six sheets together, and using six butts and three tips, first-rate shelter can be made for six men; there would be no difficulty in continuing such a shed (three sheets high) for any length required. With fifteen sheets, a double lean-to, or /\ tent, with one end closed, can be formed, $12\frac{1}{2} \times 12\frac{1}{2}$, and 6 feet high.

Some Officers may fancy that a waterproof lean-to would not give sufficient cover. I fancy that objection is more theoretical than practical. From a good deal of personal experience in tent-life, I have no hesitation in saying that, as regards temporary shelter, anything which will keep the rain off is sufficient, except in very severe winter weather. I may state that during many fishing and shooting expeditions in Nova Scotia and New Brunswick, I have rarely had occasion to use anything for myself and Indians but a lean-to; certainly there was always an unlimited supply of firewood; and bark and fir boughs were always available to put at the ends of the lean-to to prevent the snow from drifting in.


PROPOSED WATERPROOF LEAN-TO,
by Captain A.B. Tulloch.
Garrison instructor Halifax. N.S.
Scale 6 feet to an Inch
Weight.
lbs oz
Sheet 2 . 2
Pegs and String . 5
Tent Rod . 10
Total weight for each man 3 . 1
Detail of Tent Rod
(1/3 full size.)
Diameter 3/4 of an Inch.
Fig. 1.
Fig. 2.
Fig. 3.
Fig. 1. Rods connected.
2. Rods apart.
3. Shows top of Rod.
Ring and Swivel for use with Rifle or Rifle and Bayonet.
Method of using Rifle with Bayonet fixed in a lean to for 6 men.
Guy
Guy
When Rod is dispensed with and Rifle used in its place, then the total weight to be carried by each man is only 2½ lbs.
Method of using Rifle in a lean to for 2 men.
Guy
Guy
Waterproof Lean to for 6 men
12' 11"
8' 10"
6' 3"
Waterproof Lean to for 2 men
6' 6"
4' 4"
4' 0"
Regulation Waterproof Sheet altered.
Hole
Stud
String loop
Regulation Waterproof Sheet
6' 6"
3' 0"

J. Jobbins

The jointed rod might be dispensed with, by using a rifle in its place: all that would be required, when a height of 6 feet is necessary, would be a ring to fit on to the top of the bayonet so as to prevent the sheet slipping down over it. When a height of 4 feet only is needed, then a small double hook would answer, one end being attached to the stud-hole in the sheet, the other end hooking on to the upper swivel of the rifle. The ring might be permanently secured to the hook, so that either might be used as desired. The ends of the two guys might also be attached to the ring; by doing this, the rifle could be disengaged from the tent in a second, by simply slipping the ring off the top of the bayonet in the one case, and casting off the hook from the swivel in the other.

Many Officers object to a rifle being used at all for such a purpose, and I think that one objection, namely, possible injury to a soft iron barrel is perhaps reasonable, at least until steel barrels (Henry-Martini rifles) are introduced. By the addition of three small metal hooks and three eyes, which would not interfere with the tent arrangements, the waterproof becomes available as a cape.

I may add that a friend who has just returned from a journey across the Rocky Mountains—Fort Edmonton to British Columbia—informed me that his party had no shelter but a cotton lean-to; the time occupied in the journey was thirty days; there was much rain, and the thermometer was sometimes as low as 15° F. The health of the party did not suffer.

The question of temporary shelter resolves itself into this: Is it of so much importance that it is worth the trouble of carrying 3 lbs. 1 oz. (or $2\frac{1}{2}$ lbs. only if the rifle is used in place of the rod)? With continental nations who can draw an almost unlimited supply of men from their home depôts to repair the waste of bivouacing, it may perhaps be better policy not to burden the soldiers with the weight of a shelter tent; but in our case, with so much smaller a reserve to draw from, every man's life is of relatively greater value. I therefore venture to think that the question of carrying an increased number of waterproof sheets with the camp equipment for the purpose of obtaining cover when obliged to leave the tents behind, is one worthy of consideration.

HALIFAX, N.S.,
November 30*th*, 1872.

IMPROVED INSTRUMENTS FOR MILITARY SKETCHING.*

By A. H. HUTCHINSON, F.R.G.S., F.G.S., Major Royal Artillery, late Garrison Instructor at Aldershot.

THE increased attention which everything connected with military sketching has lately received throughout the Army generally, must be

* Exhibited at the Evening Meeting on Monday, February 3rd, 1873, Admiral George Elliot in the Chair. These instruments are made by Messrs. Elliott, Strand.

my apology for laying before the members of the Royal United Service Institution a short description of the following instruments which have been found of great assistance to the military draughtsman, not only in adding to the accuracy of his sketch, but also in materially shortening the time required for its execution.

THE IMPROVED PRISMATIC COMPASS.

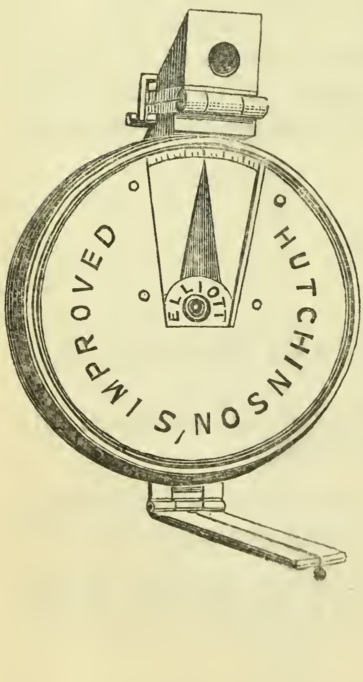
Scarcely any alteration has been made in the prismatic compass since its first introduction, upwards of 100 years ago, by an instrument-maker in the Strand, and yet it possesses two serious defects—1st. Rain or moisture can penetrate the interior; 2ndly. When the glass breaks, the instrument is all but useless.

As Garrison Instructor, my attention was called to both these defects. Compasses which had lain by for a time were constantly brought in by Officers with the movement of the card interfered with, by the rusting of pin or magnet. And again, the sketcher would return from his ground with a drawing only half finished, obliged to stop, from the breaking of the glass by a fall.

To obviate these defects, I have reduced the glass on the upper surface to a minimum, allowing only just sufficient to admit the required rays of light, at the same time making the outside so secure that the entrance of moisture is all but impossible.

This improved compass has now been in constant use for upwards of twelve months, and has been favourably reported upon by both the Military Colleges at Woolwich and Sandhurst, and approved of by nearly all the garrison instructors.

It possesses the following advantages over the old pattern:—



1. There is no loose lid.
2. It is lighter and more compact.
3. Much safer and less liable to breakage, as most of the glass is replaced by metal; and, as a further improvement, the piece of glass used, is optically worked and mathematically parallel.
4. Should the glass be broken, the instrument is not rendered unserviceable.
5. No rain can penetrate to rust the interior.
6. It is provided with spare horse-hairs.
7. Does not require a leather sling-case, although one can be used if desired.
8. The steadying-spring is padded with a soft material, which acts as a buffer to the revolving card, without denting it.

9. The sight-vane can readily be raised by the knob, even with the gloves on in cold weather.

10. It is cheaper.

Directions for use.

Take the instrument out of the morocco case, which can be left at home; place the larger strap round the neck and insert the smaller one into the loop which secures the prism, allowing the compass to hang in front of the body, with the sight-vane outwards. A slit in the smaller strap will fasten on to a button of the coat, should further stability be desired.

To take a bearing, raise the sight-vane and erect the prism; afterwards allowing the instrument to fall upon the breast till required for further use. If a fresh horse-hair be required, cut it off the bunch at both ends and draw it out. To get at the card, merely raise the top-half of the compass.

THE NEW SURVEYING ANEROID.

All military draughtsmen agree in the necessity of showing upon the drawing, the relative heights of the different hills, or other important points.

Hitherto a clinometer of some kind or other has been almost the only instrument available for the use of the military sketcher. The process is a tedious one, the time occupied considerable, and should the thread, so to speak, once be lost, it can only be picked up again by returning (perhaps some considerable distance) to any known level.

The new surveying aneroid is intended to take the place of the clinometer as soon as the student has learnt to read by eye the various slopes he is likely to meet with.

This small instrument, carried in the pocket like a watch, can be referred to at any moment.

No time need be lost in ascertaining the different slopes of the ground to be sketched. One observation at the base of a hill and another at the summit, will at once give the number of contours to be inserted, their distance apart being determined by the eye.

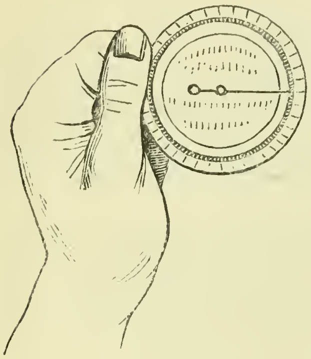
It may be also useful in ascertaining the level of some height, which can only be occupied by the observer for less than a minute, and which may be totally unconnected with any part of his previous sketch.

It can be used for any elevation up to an altitude of 3,000 feet above the level of the sea.

By its help, contours of 25 feet and upwards can easily be determined, either by running sections or otherwise.

Experiments have also been carried out which prove that, comparing it with the present tedious process, at least three times as much ground can be sketched in the same time, and with far greater accuracy.

It is carefully compensated for temperature, and forms a reliable weather-glass of the best construction.



Directions for use.

1. Always hold the instrument by the handle in the left hand, the eye level with the needle.

2. When the observer ascends, the point of the needle rises; when he descends, the needle falls; and the difference of level is read off at once on the moveable arc, each of the smallest divisions representing 25 feet.

3. It is desirable to put the instrument, without its case, in the pocket a few minutes before it is used. To set it, place the zero on the moveable arc opposite the point of the needle.

4. Should the weather be unsettled, observations must be taken frequently and for small altitudes, moving the zero-point each time. In fine weather, the arc may remain fixed throughout the day.

5. Tap the instrument lightly with the finger on the centre of the back.

Major HUTCHINSON: I should wish to say a few more words about the new aneroid, because we have introduced in this instrument, something which will be of very great service, especially to army sketchers. The compass has passed through two years' ordeal, but with the aneroid we have only had six months' experience. It has been put into the hands of sketchers at Aldershot who have used it for a month or six weeks, being pitted against Officers measuring ground according to the old plan. So great has been the advantage of this instrument, that several of those who were employed in sketching with the others, have given them up, saying that it was perfectly impossible to go on with them any longer. I have adopted the principle that for all purposes of reading heights with an aneroid it must be held in one direction. It is no use taking the aneroid out of your pocket, and tapping it, and looking at it when it is flat, unless it is one of the most expensive ones. The principle of this new aneroid is this, that you can make your contours with the aneroid only. You can find the height of any hill, however small, with it, and you can go on mapping out your country with this little instrument, and you can do so with accuracy. Suppose there is a hill there, and we have only time to rush up it, and it is of importance that we should go up there with regard to placing guns on another hill. Well, a man gallops up and down again at once and brings the information in a moment.

Captain COLOMB, R.N.: How low will the aneroid register?

Major HUTCHINSON: One contour, viz., 25 feet, but you can take half that if you wish.

Captain SELWYN, R.N.: May I ask if there is any larger scale of aneroid on that system which would register smaller variations of height?

Major HUTCHINSON: A larger aneroid than this would not suit us in the Army.

Captain SELWYN: There has been one brought before the public, of 3 inches diameter, which professes to register 1 foot. I mention this because I have been using them in mines in America, and if you could give us one which would register even 2 or 3 feet, they would be of the greatest value to the miner. My own aneroid,

(one of Elliott's) will register a difference of 10 feet at moderate elevations, but I could not always rely upon it when I got up to the 9,000 feet elevation above the sea common in the Rocky Mountains.

The CHAIRMAN: We are much obliged to Major Hutchinson for coming here and showing us these instruments.

ON BREMNER'S STEAM-STEERING-SCREW.*

By Captain GEORGE BREMNER.

IN addressing a company of gentlemen who are professionally and scientifically conversant with steam navigation, it is not necessary to enlarge on the importance of an invention such as that which I have the honour to bring before your notice this evening.

My invention, which I call a steam-steering-screw, has for its object to effect the turning, manœuvring, and revolving of a ship, and it claims to do that without the necessity of headway.

It will be readily conceded that the greatly increased length and dimensions of modern-built ships, especially those belonging to Her Majesty's Navy, require a mechanism more ready and more efficacious than the old-fashioned rudder to perform the evolutions required of them. I trust to be able to demonstrate, by the aid of the working model, that my invention would revolve a ship completely, without, as hitherto, the necessity of steerage way; I believe no mechanical appliance has hitherto been able to accomplish this.

It has justly been remarked that year by year, the sea, especially those parts of it which wash the shores of Europe, is becoming more crowded. The painful result is seen in the increase of accidents, chiefly arising from collisions. Even at the present moment the country is mourning for a fearful catastrophe which resulted from an accident of this kind. Careful navigation may do much to avoid these fatalities; well-considered sailing rules and directions may do much to lessen them; but even after both are accomplished, accidents to a certain extent will remain unavoidable. It is necessary therefore that every device or invention that will facilitate the movement of vessels under these circumstances should be applied, more especially to those steam ships whose trade leads them constantly into channels much frequented and crowded, and therefore especially liable to the diasters of collision or stranding.

The invention I have the honour to submit to you this evening will, in my opinion, if properly applied, be some remedy for this kind of disaster; for even when collision is imminent, the vessel provided with it may be turned, and the threatened collision altogether averted. I have confidence in asserting that its general adoption would tend

* Read at the Evening Meeting on Monday, February 3rd, Admiral George Elliot in the Chair.

to avoid the majority of those distressing accidents which are constantly occurring, and thereby save life and property from destruction to an extent impossible to estimate.

There are other valuable advantages connected with the steering screw, which I will indicate as briefly as possible. Among these is the power it gives of keeping a ship in position when hove-to or compelled to go at a very slow speed in heavy weather, and thus preventing her falling into the trough of the sea and eventually foundering, as is too frequently the case.

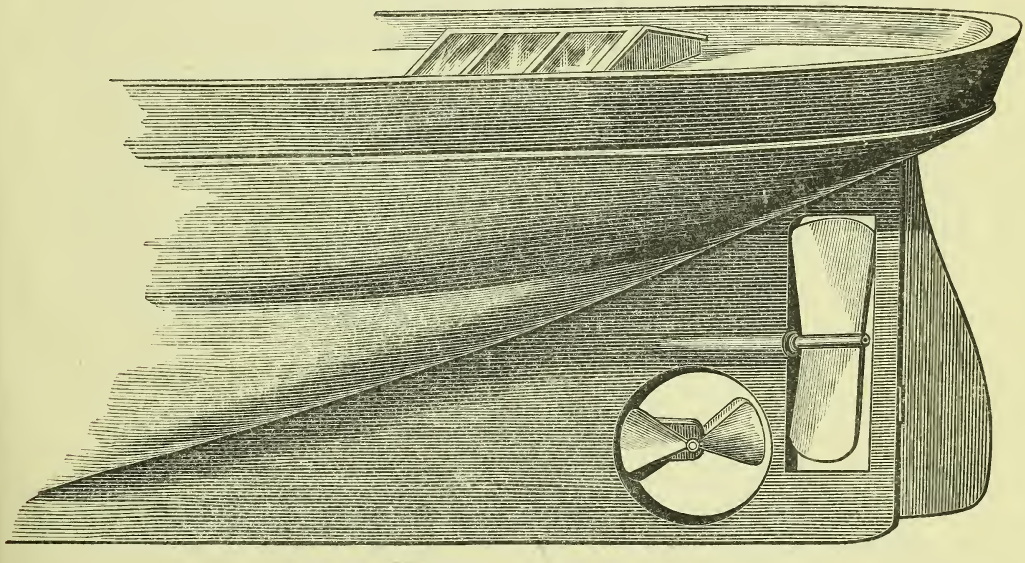
But especially when applied to ships in narrow waters would this invention be valuable, and above all to vessels sailing through the Suez Canal. The traffic through the canal, now the high road to India, is rapidly increasing. Owing to the tortuous nature of the channel, it has been found necessary to maintain a number of steam-tug boats, which are employed in the sole occupation of turning the heads of vessels, this expedient being necessitated by the inability of the ships themselves to turn in the confined waterway open to them. This of course would be obviated were this invention generally adopted; consequently a vast saving would be effected both in time and in money. Moreover, should any accident happen to the rudder of a vessel through grounding, or from any other cause, this steering-screw would constitute a second rudder, and in case of need, one by which the ship could be as readily steered as by the old one.

It is, however, in its application to vessels of war that I would more particularly draw your attention. The exigencies of modern warfare require that a ship should be able to bring her guns to bear on her opponent with the maximum effect, and at the same time with the minimum of danger to herself. Hence the adoption of the turret system. The present invention is not, however, at all antagonistic to the turret. On the contrary, it is a development of it, for instead of only a section of the ship being turned round, it would enable her Commander to revolve the ship herself. Further, I believe I am not overstating the case when I assert that the ship can be as readily turned round as the turret; if I prove such can be done, I think all will agree with me that a vessel possessing this power if she be well handled, will be a match for any two of her size without it. It must be patent to all that every means that facilitates the movements or evolutions of a ship, increases her power of both offensive and defensive warfare. There are times when vessels unfortunately find themselves so near stranding that all chance of their being saved is gone, unless they can be turned without being compelled to gain steerage way. For this one purpose only, I take it that this invention is invaluable, as we have instances of this kind almost daily coming before us. This invention is applicable to any existing ship, for iron-ship building has enabled us to do many things with ships that previously would have been quite impossible or altogether unsafe.

Prior to the introduction of the turret system, a vast amount of money was spent in the building of broadside vessels. If these vessels could be rendered revolvable, as are the turrets, it is self-evident that their belligerent power and formidableness would be infinitely increased,

and the expenditure of an enormous amount of money in building new vessels would be altogether avoided; a very material consideration in these days of retrenchment, especially when we remember that many of these vessels cannot be surpassed either in their models or their fighting qualities for sea as well as coast service. But as we must still go on building and improving, I have formed an opinion which I may be permitted to express, that a class of small ships for end-on fire, having deflective armour and fitted with one or two heavy guns so that they can approach any fort or other opposing power, and be able to deliver a destructive fire with immunity to themselves, would be a serviceable class of ships and a most important adjunct to our maritime forces. In order to maintain the position of "end-on fire," I know of no other means than the application of the steering-screw. Every practical man must be aware of the difficulty of keeping and maintaining a ship in that position.

I will now proceed to describe as briefly as possible the invention itself. One of its leading characteristics is its extreme simplicity, and it may be said to be founded on a principle already acknowledged by all conversant with naval matters.



I form a circular aperture near the heel of the ship, in what is technically termed the dead-wood, below the line of the ordinary screw-propeller shaft, and as close to the keel as possible. A water-tight trunk is fitted, either horizontally or vertically, in the vessel, extending sufficiently far into the circular aperture above alluded to, and made of sufficient strength to carry the weight and pressure of the screws when in full operation. Two chain-driving wheels are placed in this trunk, one at each extremity, having an endless chain round them and mounted on shafts, the arms of which extend outside the side or walls of the trunk, and are packed water-tight in the usual way. To the arms of the after-shaft the steering-screws are attached, one on each side, and

to the arms of the inner-shaft the motive power required to drive them, which can be led on deck to a donkey-engine or steam-winch, or worked by a small engine below. Experience has taught me that it is necessary for the actual successful working of these screws that they must be placed as low as possible in the ship, where the water may be said to be the densest and the least disturbed by the motion of the vessel, and where a perfect bite upon the water can be at all times obtained by the screws.

My patent embraces many mechanical ways, such as arms and cranks for working these screws; but for the purposes of my own experiments on these models I have preferred to use the endless chain, as I find I get immediate action with an equal distribution of strain on all parts; and as it might be found necessary at times to put on full power, without being able to commence the action slowly, my opinion is that the system of the endless chain will be found preferable.

The CHAIRMAN: I am sure we must thank Captain Bremner for the trouble he has taken in bringing this invention to the notice of the members, and for exhibiting to us such beautiful working models as those now before us.

The Journal

OF THE

Royal United Service Institution.

VOL. XVII. 1873. NO. LXXI.

Evening Meeting.

Monday, January 20th, 1873.

ERRATA.*

In a lecture delivered by Dr. Mouat on the 21st of April, 1871, entitled "A Visit to some of the Battle Fields and Ambulances "of the North of France," and published in vol. xv. of the Journal, the following errata appear:—On page 464, the words "Lady "Pigott's Ambulance," should have been "The Anglo-Belgian "Ambulance," and on page 471, the words "Lady Pigott's "Ambulance," should have been "the Anglo-Belgian Ambulance "above referred to, which was directed by Dr. James Lewis, of "Maestey, Bridge-end, Glamorganshire, with ability and success, "for which he has since received the public acknowledgments "of the French and Belgian Authorities; and of which Ambulance "Lady Pigott was Lady Superintendent of Nurses."

* *Inserted at* DR. MOUAT'S *request.*

[illegible] [illegible]

Knox, T. E., C.B., Colonel late 9th Regt. Cholmeley, H. J., Captain 16th Regt.

De Moleyns, T. A., Major R.A. Collyer, G. C., Colonel late R.E.

Bernard, T. S. W., Lieut. 44th Regt. Forbes, John, Major-Gen. Bengal Army.

THE AUTUMN MANŒUVRES OF 1872.

By Major C. B. BRACKENBURY, R.A.

THE task which the Council of this Institution has entrusted to me is a very difficult one, and I must begin by asking your forbearance. I have to read a paper on the Manœuvres of 1872, to an audience among whom are many officers far better qualified for the duty than I am, and among whom there are, doubtless, able representatives of

to the arms of the inner-shaft the motive power required to drive them, which can be led on deck to a donkey-engine or steam-winch, or worked by a small engine below. Experience has taught me that it is necessary for the actual successful working of these screws that they must be placed as low as possible in the ship, where the water may be said to be the densest and the least disturbed by the motion of the vessel, and where a perfect bite upon the water can be at all times obtained by the screws.

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Evening Meeting.

Monday, January 20th, 1873.

Lieut.-General Sir J. A. LINTORN SIMMONS, K.C.B., R.E., &c., in the Chair.

NAMES of MEMBERS who joined the Institution between the 1st and 20th January, 1873.

LIFE.

Leah, Henry, Lieut. R.N.
Close, Geo. C., Major 45th Regiment.
Rendle, Ashton W., Lieut. 1st Surrey Militia.

ANNUAL.

Twentyman, Aug. C., Capt. 4th King's Own Royal.
Yorke, P. C., Lieut. 4th King's Own Royal.
Sconce, G. C., Lieut. late Indian Navy.
Routh, W. R., Lieut. 12th Regt.
Barrow, E. G., Lieut. 102nd Regt.
Knox, T. E., C.B., Colonel late 9th Regt.
De Moleyns, T. A., Major R.A.
Bernard, T. S. W., Lieut. 44th Regt.
Dawson, H. C., Midshipman late R.N.
Dowding, Herbert W., Lieut. R.N.
Miller, D. S., Lieut.-Col. late 67th Regt.
Jones, William Gore, Captain R.N.
Wallace, W. A. J., Lieut. R.E.
Miller, H. M., Captain R.N.
Charley, John, Captain 60th Rifles.
Cholmeley, H. J., Captain 16th Regt.
Collyer, G. C., Colonel late R.E.
Forbes, John, Major-Gen. Bengal Army.

THE AUTUMN MANŒUVRES OF 1872.

By Major C. B. Brackenbury, R.A.

The task which the Council of this Institution has entrusted to me is a very difficult one, and I must begin by asking your forbearance. I have to read a paper on the Manœuvres of 1872, to an audience among whom are many officers far better qualified for the duty than I am, and among whom there are, doubtless, able representatives of

the rival armies. It has been said that "some men are born great, others achieve greatness, others have greatness thrust upon them." Believe me, the greatness of this honour—addressing you here—has been thrust upon me. All I can hope to do is to give a general sketch of what happened on Salisbury Plains, avoiding details which might lead to endless contests and recriminations; avoiding also the expression of any opinion on the terrible question, which side was victorious. What on earth does it matter? All engaged behaved like good officers and soldiers to the best of their ability; all, let us hope, discovered some mistakes in their plans or their action, and will find the experience useful on the next occasion, whether it be again only peaceful rivalry, or the dread ordeal of true battle. If anybody was entirely satisfied with himself and his work, we may set down his case as perfectly hopeless. Supposing then that we are all learning (and for what other purpose were autumn manœuvres instituted?), I will try to be a mere mouthpiece of general criticism, taking care not to accuse of the slightest fault any known individual. If, in the discussion which is to follow, the same tone can be adopted, I think no individual need suffer a moment's pain, and you and I may leave this theatre without a single bitter thought, and with some definite improvement in knowledge.

Before entering upon the definite subject of the "Autumn Manœuvres of 1872," will you permit a few general words of congratulation on the wonderful progress now being made throughout the Army of England. Cast your thoughts back to the year 1866, and you will remember how little interest our countrymen showed in the profession of arms. How dull and monotonous were our drills, how stiff and formal our greater manœuvres even at Aldershott. If you will turn over the files of old newspapers, you will find a narrow carping spirit pervading all reference to military authorities, and whatever influence the grand and patriotic volunteer movement exercised upon the regular army was all in its disfavour. Intelligent military criticisms were simply non-existent, and the only letters which appeared from the pens of soldiers were petty complaints of personal grievances. But that year, 1866, was the beginning of a new era. The great Austro-Prussian war broke out, and the Commander-in-Chief not only authorised but warmly encouraged officers to go to the scene of hostilities, and communicate their impressions of actual modern warfare to the public press. All thoughts were turned in the direction of military organization, and the necessity of military progress. It was recognised that the peaceable feeling of the country had so affected the Army that, while officers and men were as brave and well-disciplined as ever, the Army, as a whole, was not prepared for a sudden war. Since that time military affairs have been treated intelligently. There have been Royal Commissions and committees innumerable. The press has teemed with books, pamphlets, and articles in newspapers and magazines, written for the most part by real students and practical men, couched in respectful terms, and breathing a spirit of anxiety for the welfare both of the Army and the country. There was, naturally (it is always so), a strong opposition, the effect of which was to steady the reformers, and

make them careful in their recommendations, careful also to make sure of their facts. Even among the steps taken by the authorities, there were some which have not yet obtained universal approbation. On the other hand much yet remains to be done. But who that remembers the condition of the Army as to organization, education, and practical training in 1866, can look on 1872 without a thrill of pleasure and joyful confidence in the future? Even as late as 1869 the manœuvres at Aldershott, though already a visible enemy in some force had been introduced upon the field, were still little adapted to the requirements of modern armaments. It was the rule to see the troops take little or no advantage of the ground, but march straight and slowly up to their enemy, accompanied by batteries of rifled guns, which moved in line with the skirmishers, advancing when the infantry advanced, halting when they halted. There is not now a subaltern in the Army who does not understand that such tactics were against all possibility. They could not have been executed in war, and were changed at the commencement of the Autumn Manœuvres in 1871. But in those, our first manœuvres, all was new to us, as new, gentlemen, as civilized warfare with breech-loaders and rifled artillery would have been, therefore, with a wisdom which we must all recognise, much restraint was placed upon the movements of the troops. No after-abuse of the Control Department would have satisfied the country if sickness had broken out among the troops consequent upon exposure to an English climate without tents, food, or firing; no blame of a department could have atoned for lives recklessly thrown away. The result of the carefulness displayed, was manifest in the popularity of the Autumn Manœuvres as shown in the tone of the public press then and since. From that time the success of this great means of military education was assured. In 1872 the Generals were left in greater freedom—and to such an extent was their independence carried that the Duke and his Staff were as ignorant of the movements projected by a Commander for next day, as were the enemy themselves. I think you will agree that this was carrying matters a little too far even if the error were on the right side. Yet there is no doubt that the freedom granted added to the popularity of the manœuvres, which were even a greater success than those of 1871. They furnished, moreover, a new illustration of the old truth, that the way to get good work out of Englishmen is to trust them, and put them on their mettle. It is too customary to say "we cannot do this or that in England because we are not a military "country, and have no conscription." To this we soldiers may reply that, in spite of the noisy grumbling of a few, the heart of the nation is with us, and its purse always open when money is wanted for purposes of real utility. Englishmen hate paying when they get, as they conceive, no value for their money. The people do not like conscription, nor will they submit to have an army billeted upon them in time of peace. Their liberty and their prejudices are dear to them, but they are not so foolish as to refuse to pay the price of immunity from the dreaded evils, and the bill for the manœuvres is not much after all—far less than people imagine. The claims for damages have, I believe, this year amounted so far only, to about 6,000*l.*

The original scheme for the Manœuvres was complicated in appearance, though clear enough in its intention. There were several suppositious forces in the field, but their disposition was such as might be supposed to close the passage of the Wily against the southern force anywhere near Salisbury or Warminster; and, what is more, the Southern Army, whether winning or not on the first day, was to be checked, if necessary, by an imaginary force pushed on from Warminster against the Southern communications. On the second day the Southern Army was to succeed in forcing the passage of the Wily, helped, if necessary, by imaginary forces. Then there was to be a day of rest. On the third fighting day, the paper men on the Southern side were to carry Salisbury and Wilton, the Northern paper men retiring to a line—Figheldean, Amesbury, Porton. The real Northern Army was to defend the Winterbourn stream unsuccessfully, and on the next day the forces were to fight freely for the position of the line of the Avon.

But when it came to actual work, the Commanders seemed hardly to recognise the flimsy men of buckram, and showed pretty plainly that practice in tactics, not strategy, was their chief object.

There is no necessity to give the palm to either force. Tactically the Southerners succeeded on the first two days in bringing superior forces against inferior forces of the enemy; and on the last day the real tug of battle would have been for the Northern communications. Stragetically, their action might have been pronounced a little doubtful, taking into consideration the imaginary forces.

The Southern Army was assembled at Blandford some days before the opening of operations, and had much ado to practise their Militia and Volunteers, though they managed at last to have more than one instructive manœuvre. The Northerners marched from Aldershott to Pewsey, having one or two good manœuvres on the way.

On the 4th of September both armies were let loose. The Northern force from Pewsey, the Southern from Blandford. Cavalry and horse artillery to be quite free. Infantry not to cross the Wily.

The Northern cavalry, interpreting their instructions freely, started in the night, reaching and occupying the fords and bridges of the Wily early in the morning. Later in the day the divisions arrived near the river, and placed their outposts on the north side of the stream. The cavalry intended to have pushed on as far as the crest on the other side of the river, but were checked by orders from Salisbury. Whether their original instructions would have been exceeded by such action is a point still, I believe, disputed. In any case, they must have been somewhat jaded, and in that state would have come into collision with the fresher Southern horsemen, supported by a detachment of dismounted cavalry, as we shall now see.

The Southern Army, avoiding the great chalk ridge, because the roads were extremely steep and the country devoid of water, marched by the upper and lower Shaftesbury roads. There is not time to give exactly the dispositions for the march, nor does it seem necessary. Suffice it to say that their object was to seize and hold the range of hills commanding the Wily. The cavalry marched first—the heavy brigade to


Map to Illustrate
MAJOR BRACKENBURY'S LECTURE
on the
AUTUMN MANŒUVRES
OF
1872.
Pewsey
Newington
Market Lavington
East Everley
Imber
Tilshead
Haxton
WARMINSTER
Figheldean
Orcheston St Mary
Orcheston St George
Chiltern All Saints
Shreenton
Maddington
Milston
Durrington
Bulford
Maiden Bradley
Stonehenge
AMESBURY
Winterbourn Stoke
Berwick St James
Stockton
Steeple Langford
Wilsford
Allington
East Buscombe
Stapleford
Chicklade
Porton
Berwick St Leonards
HINDON
Bishops Fonthill
Chilmark
Middle Woodford
East Knoyle
Teffont
Dinton
Baverstock
Winterbourn
Old Sarum
Stratford
Gillingham
Sutton Mandeville
Fovant
Compton Chamberlain
WILTON
Netherhampton
SALISBURY
LONDON AND SOUTH WESTERN RAILWAY
Ansty
West Harnham
Bishopston
Toney Stratford
Chalk Stream
SHAFTESBURY
Todbere
Melbury Down
CRANBORN CHACE
SOMERSET AND DORSET RAILY
Fontmell Magna
Marten
Downton
STURMINSTER NEWTON
Handley
Whichbury
Farnham
CRANBORNE
DORSET BRANCH
River Avon
Pimperne
Tarrant Monkton
BLANDFORD
Witchampton
WILTS SOMERSET AND WEYMOUTH RAILWAY
Maiden Newton
SOUTH WESTERN RAILWAY
DORCHESTER AND SOUTHAMPTON BRANCH
RINGWOOD
WIMBORNE MINSTER
DORCHESTER

J. Jobbins


S
DORCH

Lady Down, the light brigade to Fontmell Down—dismounted men, about 500 strong, by rail to Tisbury, then to push on and occupy the roads through the great woods. However the affair might have turned out, it is impossible not to regret the lost opportunity of seeing what two forces of English cavalry could do in their legitimate work of covering the fronts of their respective armies. The infantry divisions marched to Fontmell Magna and Fontmell Down.

At two o'clock on the morning of the 5th, the Southern head-quarters were completely informed of the positions occupied by the Northern brigades, and the printers were set to work bringing out the orders for the contemplated attack. On that day the Northern cavalry camp was shelled by the Southerners, and a partial cavalry attack from the North was repulsed by a well-executed combination of cavalry and guns. The infantry pushed on to Fontmell Down and Teffont.

Reports from scouts informed the Commander that the Northern cavalry and part of the infantry had bivouacked above Codford. The remainder of the infantry were on the other side of the Winterbourne stream. He determined, therefore, to adhere to the orders already printed.

The gist of these orders was as follows:—(Remark, if you please, that the Southern Army boldly neglected the imaginary advanced guard of the enemy's Bristol force at Warminster, because if a division could be crushed by a very superior force, the enemy's line of defence would be broken, and part, at least, of his troops demoralised.)

The left of the Northern Army must be deceived and kept inactive, if possible. For this purpose, a small force of the three arms was sent as a theatrical army, circling round in and out of Dinton Beeches, to represent the march of a large force. It is all very well to laugh at this notion, but similar *ruses* have frequently been successful in war.

Four regiments of cavalry and a battery of horse artillery were to march round the west end of Great Ridge Wood, and form in a sheltered position in Long Bottom. Sir A. Horsford's Division with a battery of Royal Horse Artillery added, to pass through Great Ridge Wood, and keep on the western slope of Boyton Down. The artillery to occupy a position near Boyton Farm, and remain masked by the slope and a large hedge there, unless it should be necessary to open fire on Upton Lovel.

Two brigades of infantry and two batteries to pass between Stockton and Great Ridge Woods, and halt behind Sherrington Down.

One brigade of infantry, two regiments cavalry, and ten guns, to be posted behind Stockton Wood, to guard the right of the Army against a counter-demonstration of the enemy.

When all should be in position, the cavalry were to push along Titherington Bottom, cross the railway near Cortington, the river at Knook, and, taking the Chiltern Road, form up behind the belts of trees on Horse Hill.

The whole of the infantry to cross at Knook and Upton Lovel, forming behind the ridge between Horse Hill and Codford. Only the force at Stockton Wood was to stand fast.

As soon as the whole were in position, the four batteries across the river to advance as near as feasible, say 1,400 yards, and open fire on Codford Hill. All the guns on the south side of the river to push forward within range, and so bring a cross fire to bear on the enemy. Under cover of which, Codford Hill was to be attacked and carried by five brigades of infantry. The whole programme was carried out. The Northern force retired from Codford Hill, but their cavalry claim to have watched the Southerners throughout, and to have at one time enfiladed their attack by artillery fire. However, the Warminster imaginary force was brought up by authority and the Southern Army was sent back to its old camps. The left of the Northern Army was not brought up in time to be of any assistance.

Such was the battle of the 6th September.

It is curious that the attack should have been made on the wrong flank, strategically speaking, and that the original design of the campaign as planned before the armies went into the field should have supposed that the attack would be there on the first day. It is also curious that the Commander of the Northern Army is said to have expected to be attacked, as he was, on the wrong flank, strategically speaking.

On the 7th, the Northern force again stood on the defensive, and this time, with doubtful right, the Southern Army attacked by Wilton and Wishford. The hardest work again fell to Horsford's Division, which marched from camp round through Wilton to Newton Hill. The Guards marched admirably, doing about 26 miles as their day's work.

The cavalry made demonstrations near Dinton Beeches, to keep the enemy's right on the west side of the Winterbourn stream.

The second division marked by Grovely Wood, waited till Horsford's troops appeared on Newton Hill, then attacked and carried Wishford under cover of artillery, so as again to bring a large force against a weaker one of the enemy.

But there were doubts as to the propriety of the passage at Wilton, where was supposed to be an imaginary Northern force of 2,000 men. The Northern cavalry, too, having crossed at Wilton, came upon a battery and claimed to have taken it together with Sir A. Horsford and his staff. A long delay took place, while the Umpire's decision was still unsettled, and this delay is said to have thrown out a proposed combination formed by the Chief Cavalry Commander on the Northern side.

A small force of Northern cavalry crossed at Steeple Langford, but without effecting anything.

That night the Southern Army encamped on Little Down and Lamb Down. The Northern Army to the east of the Winterbourn.

The 8th was Sunday, and the troops rested. The Commanders and Staff reconnoitred and the conclusions they arrived at were:—the Northern Army to turn the enemy near the Wily, the Southern to turn the Northern right flank by Orcheston and Maddington. But next morning the Commander-in-Chief ordered the two forces to occupy positions facing each other, and as the dispositions had to be made on

the spur of the moment, the battle is hardly worth studying. On this day as on others, was shown the difficulty of getting umpires' decisions, rapidly given, and the impossibility, on the present system, of ascertaining what object has been selected by batteries for directing their fire upon. Some modification of the system seems urgently required.

Certainly guns were firing into friendly troops. On one occasion an Umpire was sent for to put a force of cavalry out of action. Before he came the claimants discovered that the supposed enemy was really part of their own army. So they found some other subject to talk to the Umpire about.

The Southern Army was now supposed to be in possession of Salisbury, Wilton, &c., and encamped near Berwick St. James. The Northern Army retired to the east of the Avon, and encamped north of Amesbury, with orders to take up a position to cover the town next day.

On the 10th, the Northern force crossed the river at an early hour, and took up a position west of Amesbury, sending the cavalry well round to the right, to anticipate a flank attack there. But Sir J. Mitchel determined to shift his line of communications to that of his imaginary force through Salisbury, a very difficult task to be performed in one day in war, and led his whole army by a flank march to turn the enemy's left and cross the river at Netton Bridge, hoping thus to seize Amesbury. His light cavalry brigade meanwhile endeavoured to attract the enemy's attention by showing a bold front, as if covering the advance instead of the flank march of the army. They were spread out in a single line of open order, holding Rox Hill in some force, and having only one battalion in support.

The second division crossed safely. The first division endeavoured to help the cavalry with one brigade before crossing. It suffered severely, though the enemy's advancing line was enfiladed by a powerful fire of guns already across the stream. The Southern light cavalry must also have suffered considerable losses. But, supposing the result aimed at by the army to be a legitimate one, losses in achieving it might be compensated by the gain. The Southern heavy cavalry certainly gained the London Road, but on the other hand, it was believed by the Northern Army, that they, not the Southerners, held with imaginary forces the passages of the Avon.

After one day of rest there came that magnificent parade which sent a thrill of enthusiasm through the breasts of more men than soldiers.

And now, gentlemen, I presume you expect some criticisms on these manœuvres. Neither would you desire nor I deign to utter that miserable carping whine which was once prevalent when the Army and its Commanders were brought under review. We must then have some standard of comparison, something to test our opinions by. It would be vain and foolish to go back to the days when the ranges of artillery were less than half what they now are, when infantry could only fire with about a tenth the rapidity, and to a sixth or an eighth the distance now possible to them, when the wealth of nations was comparatively undeveloped, when roads were bad, railways and telegraphs

non-existent. Much is indeed to be learned from those times, nor can we ever hope to excel in conduct and daring the deeds of our gallant English forefathers. But the means at our disposal are very different to theirs, and just as one step after another has led on from the Greek Phalanx to the Roman Legion, then through the desultory combats of the middle ages to the machine-like accuracy of the Prussians under Frederick the Great, when whole armies stood in line, or moved simultaneously to a flank in one vast column, capable of wheeling into line at any moment; on to the corps organization of Napoleon under separate commanders and its development by Prussia; so must we look for the steps incumbent on us to take under the new order of things. Now it might be possible for a military genius to foresee all possibilities and difficulties, and work out from his calculations in the closet a system capable of answering all ends. But the task is almost above what we can conceive of human faculties, and it certainly has never been performed. The Prussians have had to introduce one improvement after another, derived from their experience in three wars during nine years. Surely the wise course for us is to study with extreme care the actual processes and results of modern war; to note especially what changes have been forced upon armies by experience, and then, taking their general advance as a guide, to see whether we are moving in the same direction, and how far such changes could be carried in the English Army without violating our national usages or the traditions of which we are so justly proud. We know of one nation whose arms have been marvellously and invariably successful against the greatest military Powers, a nation which has risen by force of arms, and knows well that by arms alone can its present position be maintained in the face of the most jealous rivalry. The thoughts of that armed nation are constantly bent upon military progress, and no English visitor to Prussia can fail to be struck by the warlike atmosphere he finds himself breathing there. Are we to refuse to learn the lessons extracted by Prussia from her last few years of blood and iron because we were not there fighting ourselves? Because our circumstances are not the same as hers, and do not admit of copying her path exactly, as, God forbid we should ever do, are we to say that the only illustrations of modern war placed before our eyes are also the only ones we will not learn from? I am impelled to call your attention to these things because there is now a class of men who, unable or unwilling to designate the direction which progress should take, try to hinder the labours of others by branding them with the epithet of "The Prussian School," as a term of opprobrium. Yet it is these very men who would, if they could, saddle this country with the torment of general service, thus copying from the Prussians the one measure unsuitable to our national system undemanded by our necessities. It is very curious to see the different effect produced on different minds by observation of what is going on abroad. One Officer comes home, and tells what experiments are being made in different places before deciding upon the alterations to be permanently adopted and crystallised in the drill-book; tells, also, that no rules are to be considered as absolutely binding, but that Officers are being so trained

in tactics that everyone of them may be trusted to act rightly and above rules according to circumstances. Another, with the same opportunities, says, that there is nothing to be learned because everything is in confusion. The one explains how the artillery is being reorganized to give it a power of less desultory action, to bring it into greater harmony with the corps organization, and to increase its numbers; the other asserts, that it is absurd to study the Prussian artillery, because it is in a state of revolution! And so on throughout the whole range of subjects. Now, I appeal to you, what has been the course by which England has risen to the pinnacle of power on which she now stands? Imbued with a thoroughly practical and progressive spirit she has taken as a foundation the courage, energy, and industry of her own sons, and built upon these solid qualities an edifice composed of all that laid ready to her hand, wherever it came from. Nay, like the old Venetians, she has been at the pains of sending abroad and bringing back the costliest materials to add to the stateliness of her building. Nearly all our arts and manufactures were imported from abroad, but brought to perfection by the energy of Englishmen. Nothing but blind prejudice could deny that we imported fire-arms, the casting of iron guns, the line formation, horse artillery, and the very system of rifling ordnance, which is now universal. We might as well reject the Henry-Martini rifle because Martini was not an Englishman, as the experience gained in war by the Prussians, because our ways are not as their ways, nor our thoughts as their thoughts. Therefore I will not heed the cuckoo cry of the Prusso-phobists, but try to bring the light of the experience gained in the late wars to bear upon our principles and practice in the last autumn.

It would not become us here to question either the general idea or the particular suppositions given to the Commanders each day. There were many difficulties to be met—chiefly the uncertainty of supply. The dispositions of the Generals had to be rather hampered by imaginary forces brought on the field—one of those Prussian practices which seem to me unnecessary with us, because, having no regular system yet devised for the thorough supply of an Army in war, we are trying to work one out in peace, and should, therefore, attempt something which would really test the Control Department as nothing has yet done. A very simple plan would be to give each Army a certain road as its line of communications, which it must not lose. Then, perhaps, there would be no necessity for visionary forces, whose effect on the day's fighting seem to be always open to argument. Having adopted the principle of Autumn Manœuvres from the Continent, we may well improve upon foreign practice. Concerning the action of the two Armies, it may be remarked, without offence, how the old maxim was proved, as it has been on hundreds of occasions, that the way to defend a position by a small Army is not to extend, hoping to cover it all, but to defend with tenacity the most important point and, with the rest of the Army, deliver a counter-stroke as soon as the enemy's plans have been developed. There appeared to be, also, among some Commanders, a tendency to move about restlessly, busying themselves with details rather

than grasping the situation and issuing few orders, but those well considered and to the point. When riding with the Staff of Prince Frederick Charles, during hot engagements on a large scale, I saw quite another system. The Prince moved very little, and never far from the spot where all despatches were to be sent. Often dismounted, he was always in close communication with his Chief of the Staff and Quartermaster-General, who usually stood beside him. Maps were frequently consulted; the reports of messengers, the evidence of personal sight and hearing were all calmly considered, and when the various divisions and brigades had attained the positions marked down for them beforehand, the maps were folded, the horses turned quietly in the direction of head-quarters for the night, where the members of the Staff began forthwith to write orders for the morrow. This quietism was a great characteristic of the Duke of Wellington and the great Napoleon. Can we have better examples?

The English Staff shows signs of talent and vigour, but there seems to be some fear lest its very efficiency should become a danger. The progress of one branch of the Army must not be made at the expense of others. That admirable pushing energy, so characteristic of the Briton, causes every new or newly trained department to seize all the work and all the power it can. The position of Staff Officers is or ought to be a definite one. They are not Generals nor, in any sense, leaders of troops, and it would tend towards the detriment of the Army if the Staff came to be looked upon as a body of Commanders, or even to be referred to on all occasions. The Generals and Colonels must themselves learn a great many things which are too often considered to be Staff duties. Theirs is the credit, in case of success; theirs should be the responsibility. A little thought will show that there is need of a warning on this subject. On the other hand, there appears to be a want of system in the relations between the Staff and the Control Department. An article, published in *Blackwood* last November, pointed out that while the old privilege of the Guards, that of taking orders from none but their own Officers, has been abolished, the Control Department, the very last that should do so, has, by some means or other, become possessed of the distinction taken from the Guards. In war, nothing more fatal can be conceived, and while we should make all allowances for a new department doing its best, no doubt, we cannot help seeing that there is rising up in our military system such an *imperium in imperio* as bids fair to deprive the Army of that feeling of brotherhood than which nothing is more essential to its efficiency. It is impossible to suppose that so fatal a step can be dreamt of as making the civil element within the Army superior to the military. If so, we might sheath our swords for ever; and the very appearance of such a notion is in itself to be avoided. Duty and discipline will always insure obedience, even to the most fatal scheme, if propounded by authority; but there is a feeling of honour and a pride in bearing arms which cannot be violated, especially in a Volunteer Army, without the greatest risk to *morale*. Even a Bismarck occupies a secondary position in war, and the expression, "Arma cedunt togæ," must not be thought applicable to the battle-field. It is said that there

were about 120 Control Officers employed at the Autumn Manœuvres. For purposes of transport the teams of several batteries were taken without their own drivers; my own battery furnished 36, besides taking up the transport duties at Colchester, 18 miles from Ipswich, where the battery is quartered. No less than 455 of the horses employed in transport, chiefly for the reserve forces, came from the Royal Artillery. It may also be considered not unworthy of remark that a very large proportion of the horses bought for the occasion were sent over from the continent. The same assistance was given in other places, yet, with all this, most of the supply was done by contract, and even then, preserved provisions had to be resorted to. Surely, while giving our adhesion to the principle that one department should be responsible for the supply of all articles not being actual arms and ammunition, we may declare unhesitatingly that the energy and ability of Control Officers have not yet succeeded in organizing a proper system of supply for the English Army. It would be foolish and unpatriotic to shut our eyes to this fact, and leave to the moment of trial what can so easily be arranged now, in time of peace. I would suggest that this year the two forces should be supplied, as in war, from depôts placed on their respective lines of communications, where the Contractors should deliver their stores; not that Contractors should be trusted to deliver them at points previously arranged for the encampment of the forces, no matter who wins or loses. It is unquestionable that the friction between the Army and its Supply Departments is, at present, tremendous, and much power is lost thereby. The new system of regimental transport was found to work well and was very popular, but it needs a little more organization.

We now come to the tactical action of the three arms—Infantry, Cavalry, Artillery. I put them in the order usually adopted, though there is a rising school in Europe which asserts that success is, in future, likely to follow that Army whose Cavalry and Artillery are most numerous and best trained. However this may be, the idea is too new and radical to be worth discussing at present in England, only it should be stated that the head-quarters of the movement are in Russia, and it is calculated that the Czar could put not less than 120,000 hardy horsemen in the field.

Since last year's Manœuvres, the Commander-in-Chief has taken a step, the consequences of which are, in the opinion of most military thinkers, likely to prove an inestimable advantage to the Army. We may each have our particular crotchet as to the best formation of Infantry to meet modern weapons. For my part, I care little whether the working tactical unit be a company of 250 men or a half battalion, which, though its nominal strength may be 500, will scarcely ever put in the field actually fighting more than 350 bayonets, if so many. The great fact is that Infantry Majors are now told they are responsible for the order of attack or defence, and that they are to act, not according to hard-and-fast rules, but according to their own intelligent apprehension of the circumstances of the case. This, and not any special order of battle, is what we had to learn of the Prussians. Sometimes line will be right, sometimes column, sometimes swarms of

skirmishers. Henceforth, there can be no reasonable grounds for advancing a whole brigade in line, under the enfilade fire of several batteries. But the Majors will have to take care that their tactical acquirements are equal to the trust reposed in them; they will have to lead their half battalions with careful forethought, not unnecessarily exposing their men, but, on the other hand, not losing their proper place in the line of battle. Depend upon it, no ordinary vigilance will be required to fulfil all the conditions imposed upon them by the development of modern Artillery and fire-arms. To say that they are sure to do well after a little practice, is only to repeat that absolute truism—"Whatever is set before English Officers, by authority, as their standard of efficiency, will be attained by them, and as they have hitherto surpassed all nations in the cleanliness, the order, and the discipline of their men, so will they now take their place in the front rank as thoroughly practical tacticians." This is as complete a certainty as that the sun will rise to-morrow morning. The independent character of the Englishman, his obedience to law, and confidence in his Officers, are the very qualities most suitable for the new system of tactics, and I challenge, as the real croakers and alarmists, those who deny the sufficient military intelligence of the British Infantry Soldier. He is steadier than the Frenchman, brighter in spirit than the German. He is well fed, therefore hard in muscle; well disciplined, therefore trustworthy under all circumstances. Emancipate him from barrack-yard routine, and he will grow like a plant brought from a dull room into air and sunshine. Trust him and teach him, he will become once more a model for all nations. Pray let us not forget that it was not only for steadfast bearing in line that our infantry used to be celebrated. Have we any reason to be ashamed of Crawfurd's men in the Light Division? And, what is more, there is hardly a single development worked out by the Germans lately, which had not been advocated, many years ago, by the glorious spirits trained in the Peninsular War.

The requisite training both of Officers and men is to be attained by frequent small manœuvres all the year round; and since the principle of giving responsibility to comparatively junior Officers has been recognized, there can be no shadow of a doubt that they must be given practice during the year under the critical eyes of Generals commanding in districts. There appears to be still a good deal of backwardness in outpost duties, especially as regards communication with the main-body. On one occasion the outposts placed to watch the Wily were to my certain knowledge ignorant of the fact that the battle was over, and their Army in full retreat. When they were afterwards attacked and driven in, they had no idea of the direction they should pursue to join their division.

The most remarkable mistakes, if I may venture to call them so, made by the infantry, were two of an exactly opposite character. While whole brigades marched in column under fire of the enemy's artillery, and deployed into line within range of guns and sheltered infantry, excellent positions were given up with a mere show of resistance. It is difficult to understand how two such practices can

prevail side by side. The fire of troops posted behind banks or walls is quite invincible until the men are demoralized by a heavy concentrated fire of artillery. They may have to yield to a flank attack, certainly not to one directly from the front. This is a rule almost without exception. Inferior numbers can hold their own against a superior force for a long time, if the men are not demoralized. Take for example the attack upon Wishford, on the 7th. A division of infantry debouched from Grovely Wood, in column, and threw out skirmishers who advanced slowly across the open. The railway embankment made the place a strong fortification, but nearly all the defenders were withdrawn without a struggle, and the village was suffered to pass into the hands of the Southerners who thus found themselves safely ensconced behind houses, &c., and could from their sheltered position bring a superior fire to play upon the defenders. Now, I venture to suggest that a better course would have been to have held Wishford, with great tenacity, and thus have prevented the passage of the river, while directing all available troops against those of the Southern force already across the river at Wilton. Surely we should not so abandon positions in war. Why then play at doing so? If anything, we should exaggerate the effect of that British virtue, tenacity. The improvement in marching power was striking to all who had seen the manœuvres of the previous year, and if I might humbly express a general opinion, it would be that the practice of two seasons of Autumn-Manœuvres and the new order issued from the Horse Guards has more than doubled the efficiency of the infantry, though it is manifest that serious tactical studies are still necessary.

The cavalry seem now to recognize a new standard of efficiency, and some of their work at the manœuvres this year, was as good as could be; but through it all, or almost all, there was visible a dread of losing prisoners, of being taken unawares, in short a terror of making sacrifices. There are certain possible evils in peace manœuvres, but now that they have become an English institution, we need not be afraid of facing the dangers attending their practice. It is said that in Austria the manœuvres tended at one time to make the Generals over-cautious, and therefore weak. Warned beforehand we may avoid falling into the like error which seems especially dangerous for cavalry. We are justly proud of the fine men and fine horses, but there is a tendency to take a little too much care of them. It might, perhaps, be an exaggeration to say that cavalry are made to be sacrificed, but it would not be far from the truth. At any rate, the dread of sacrificing his squadrons is a great weakness in a cavalry commander. The chief use of cavalry in modern war is well understood to be the perpetual watching of the enemy. It is not sufficient to send out a reconnaissance at day break and rest contented for the remainder of the morning with its report. The cavalry should be always feeling the enemy, broken into small detachments which can avoid observation. Horsemen should occupy every hill whence the enemy's camp may be seen, and the movements of his every column. It is in vain for the cavalry of a defensive army merely to cover the front at a little distance from the battalions until the enemy's appearance tells what his columns have been doing. If

cavalry are the eyes and ears of an army, they should be perpetually *seeing* and *hearing*, not only *waiting* and *listening*. Moreover, every English cavalry regiment should be accustomed to go across country. A horse's leg may be broken now and then, or a man's collar bone, but what is that compared with perfect efficiency? It has never yet been supposed that the main duty of soldiers was to take care not to hurt themselves, nor is it easy to see why the men and their horses should be so carefully restrained by Officers who are always ready to risk their own necks in the hunting field or the steeple-chase. In the *Revue Militaire de l'Etranger*, of the 1st January, there is an interesting article describing the practical training of the Austrian Cavalry. A correspondent of theirs had been at the Camp at Bruck, the Aldershott of Austria, in the summer, and had not only seen the cavalry worked constantly across country, as I have myself seen them, but had specially observed two squadrons which in charging came upon a broad ditch, and leapt it without slackening rein or breaking their ranks. He, or another correspondent, subsequently studied the system by which such a combination of steadiness and dash is achieved, and you may read his article in the number for the 1st of January. It is no part of my business here to enter into the subject further than to assert that the Austrian Cavalry moves in good formation and with sufficient steadiness across any fair hunting country, and is besides accustomed to climb up very steep places, to cross marshes and to swim rivers. So long as our magnificent cavalry were kept perpetually pottering about in barrack-squares and drill-fields, no such activity as this could be expected from them, but we have at last arrived at a point in military training when exercises so practical in their nature may be advocated without exciting derision. Of course the English Cavalry take care of their horses, of course they would charge foreign troopers with perfect gallantry and irresistable power; the only question is whether they are not over-afraid of hurting their horses and over-devoted to the idea of charging. Activity being the special characteristic of cavalry and intelligence duties not the least important part of its work, the development to be looked for as compensation for the increased power of infantry and artillery should surely take the direction of increased activity and intelligence. It is remarkable that among the best of the military students tested by examination at the Staff College, you always find Cavalry Officers, and nearly all whom I have lately come across, are most eager to develop the efficiency of their arm, and well qualified to do so. But why waste words in saying what everybody knows? Autumn manœuvres will soon show what remains to be learned. English Officers will take care to learn it.

Concerning the employment of artillery at the manœuvres, the first striking fact is, that the Generals seem to have made up their minds that the use of modern artillery is something out of their reach, since guns no longer stand in line with the infantry. There was only once, so far as I know, anything like an effort made by a General with a mass of artillery fire—such an effort as would crush and demoralize whole brigades or divisions of the enemy. It would be a

great mistake to suppose that Artillery Majors advocate being left entirely to themselves to work without combination of batteries in a desultory manner. Indeed, no one knows better than they, that the solitary action of one battery can seldom effect much, any more than one regiment of cavalry or one battalion of infantry. Infantry cannot carry a position by front attack if it be well defended by steady troops. The steadiness of the enemy must be knocked out of him by a heavy constant rain of shells, crashing and bursting among them, and this requires a considerable number of guns, not necessarily ranged side by side, but directed on the same object by the same intelligence. To succeed in handling his guns so as to make the most of them, the General must have definite plans, and communicate them to the Commander of his artillery, as he would to the Commander of an infantry division or brigade. There is, no doubt, much desultory work to be done by single batteries, whose leaders are well trained in tactics, but all must be accustomed to work together for a common object. The sphere of artillery action is no longer the same as that of infantry, but the law that combination is necessary for effective work remains invariable. It is not common for Generals in our Army to study very deeply the handling of artillery. Even the great Duke was not an adept in the science and tactics of this arm. For various reasons, which there is not time to give, the knowledge was less necessary then than it is now. Sufficient for us is the fact, that no single front attack made by infantry during the late war was successful unless prepared by a long, concentrated fire of guns. How necessary is it then that the field artillery should be handled by men well acquainted with its peculiarities, and kept near the front of the column of march, so that it may be ready to commence its work at once upon catching sight of the enemy, losing no time, but acting vigorously to cover the deployment of the infantry.

Artillery has two very distinct functions in an army organised upon modern principles. There is the Divisional Artillery permanently attached to infantry or cavalry divisions, and the Corps Artillery which acts as a separate body, and is too often spoken of in our service as reserve,—a complete misnomer, unless you like to call "reserve" that which goes first, or, at least, second, into the front line of battle perhaps before a single infantry soldier is engaged. The divisional artillery may—probably will—open the ball, acting in small bodies such as batteries, and in a comparatively desultory manner; then they will be supported by part or all of the corps artillery sent up to range itself beside them. Some of us may like it, others not, the fact exists, and has been stated again and again upon authority, that infantry cannot attack positions defended by steady troops armed with breech-loaders, until the way has been prepared by artillery fire, acting for a considerable time. To avoid delay and discomfort of the other troops, the guns should always march near the head of the column. Is not the first order on seeing the enemy, invariably, "Bring up the artillery?" Surely then the nearer the artillery is to the front, the less will be the delay. Divisional artillery will probably act by single batteries, or by twos and threes—the corps artillery in a mass. But how can it

be massed if there is only one battery not attached to divisions, as was the case this year? The Prussians, taught, let us remember, by failure in 1866, have always since pushed their artillery well to the front at the commencement of battles. They have now four batteries to each of the two divisions in a corps, and about double that number to act freely as a Corps Artillery. Moreover, they have raised the rank of the Officers commanding. Surely, after 1870–71, there must be something to learn from Prussian artillery experience.

It would not become me here to say anything of the appearance or steadiness of the English artillery, and it is the less needful because praise enough and to spare was lavished upon them in 1871. I hope you will agree that they have not degenerated. For Artillery Officers, as well as others, the progress now to be made is in the direction of tactical studies. Only once more I may be permitted to ask, where are the "range-finders"? Any one who took the trouble to ask questions at the late manœuvres must have felt sure that no want was more felt than that of ascertaining the range as accurately as possible before unmasking the guns. And it may be doubted whether another adjunct to each battery should not be a very strong telescope. When we think of what a battery costs, it must be agreed that everything which can add to its power at a moderate price should be given. "For want of a nail the shoe was lost; for want of a shoe the horse was lost." That English soldiers, whether artillerymen or not, will make the best of what they have, may be taken for granted; but do not let us be so illogical as to say, "Therefore they don't need this or that." Give it to them, and once more they will make the best of it.

Escorts for artillery were generally taken from regiments, thereby breaking up squadrons or battalions, and this was even the case sometimes when the enemy was far away. So long as a battery is with other troops, the nearest of them are its escort. It needs no other, and artillery, if detached in presence of the enemy, requires a stronger escort than a handful of infantry or cavalry. There is a growing opinion, both within and without the artillery service, that each battery should have, *as part of its regular strength*, a few mounted rifles to act as scouts and messengers. Trained by the Majors commanding, they would become infinitely more serviceable for the special purpose than any detachment of cavalry however good, and they would supply the place of larger escorts.

Concerning marches, it is to be observed that there was frequently a most remarkable absence of advanced guards and flanking parties; and if one thing more worthy of notice than another was proved in the late war, it was the usefulness of strong advanced guards. Perhaps it would be well to practise advanced guard duties as well as outposts a little more frequently and seriously than is the habit at present. It would, indeed, be a shame if, after introducing the practice of "Autumn Manœuvres," an English Division were ever attacked unexpectedly in camp or on the line of march.

But the subject to which I most earnestly ask your attention in the discussion is the absolute necessity of preparation for the manœuvres. Drills are not preparation enough. They help to discipline men, they

bring soldiers steadily into the presence of the enemy, and move them steadily again after the battle is over; but the details of the battle itself no drills will teach them; nothing but continual practise throughout the year of small bodies under junior Commanders, criticized by the Generals. How many Officers were there at Salisbury, I wonder, who felt themselves masters of such details as the attack and defence of bridges, villages, woods and positions of various kinds? Yet battles now consist almost entirely of such work. We may get out of our heads entirely the vision of troops beautifully drawn up in lines of battle, squares, or columns on plains. Rifled artillery and breech-loaders have settled all that for the present. The Army which can once get its enemy well in sight as the Prussians had the French at Sedan without being exposed themselves, may consider the battle as good as won. No, the battles of the present and immediate future must consist of a series of attacks upon positions, defence and counter attacks, till one side is short of ammunition or demoralized by one means or another, either by turning a flank or breaking the centre, or cruel bombardment. The Army whose Officers and men are best trained for these small but important actions, will, if its men be brave and true, have a definite advantage over its antagonists. There is no difficulty in practising such small manœuvres all the year round. You have only to march two forces into the neighbourhood of camp or quarters, and pit them against each other as you do the two corps at the manœuvres, arranging your suppositions so as to make sure of producing a useful struggle of one sort or the other. I can vouch for this from personal experience. With my own battery and a squadron of Dragoon Guards, at Ipswich, we really succeed in learning some practical lessons, and our little manœuvres are very popular both amongst ourselves and in the neighbourhood. What is difficult for cavalry and artillery is extremely easy for infantry, and moderately easy for the three arms combined. The War Game has been introduced among us, and is already popular. As far as it goes it is invaluable. But after all a map is not actual country, and ordering the movements of small pieces of metal is far less confusing than moving real bodies of troops, no matter how small. By practice, too, one comes to understand how precise orders must be, and how simple all plans should be in view of the probable blunders of subordinates. The men engaged, acquire almost a new sense and grow rapidly in military intelligence. At first you will find cavalry patrols coming in and reporting that they have seen the enemy, but without counting his force, or guns taking up the most exposed positions. But faults are soon corrected and not repeated. Here is a case which actually occurred. A young Cavalry Officer who had handled a small force of dragoons on an open heath, for a long time, so well as to protect his guns from capture by a superior body of cavalry, found himself at last about to be attacked in front and both flanks. With right judgment he beat a hasty retreat, but coming upon two of his own guns in action, on a road bounded by banks and hedges, he, in the hurry of the moment, sped past them, calling to them to limber up, instead of rallying behind their protecting fire. The result was that the enemy came up when

the guns (or rather one gun representing two), were limbered up, and on the point of retiring. Depend upon it if he lives to be a hundred years old he will never make a similar mistake again. It is far too common to hear an Officer of one arm saying, "I do not understand the use of the other arms, I wish I did." How is he to acquire this knowledge except by practice? Only try such manœuvres, and you will find them interesting, instructive, and an immense help to discipline.

Last year, about this time, I had the honour of proposing here that the English Army and Navy should work out together all the details of coast attack and defence. Since then, Mr. Vernon Harcourt stood on this platform calling for information on the means required for attack of the English coasts. Though his opinions were ably combated and finally refuted, it was striking to find how little accurate information was elicited as to the proportion of men, horses, and stores required for the invasion of England and the transport required for them; the time taken in embarking and landing, and the chance which the hostile flotilla would have of avoiding our ships. Permit me to ask again, is this worthy of the greatest naval power in the world with the best railway communication, and an excellent though small Army? I again propose the embarcation of a force of 10,000 men under an Admiral whose only instructions should be to land them on the coast if he could. Whether he succeeded or not, it is difficult to over-estimate the amount of knowledge which the naval and military services would acquire by such a manœuvre, and it need not of necessity be performed in autumn. It is said that an Officer well versed in the ways of the War-Office, engages that he would not only land a division, but put the men into barracks in London, without encountering serious opposition. Little requires to be said of the Militia or Volunteers present at the manœuvres. Some splendid corps were employed, but all experience has taught us that it is most perilous to place half-trained troops in line against a regular Army, and while the zeal of both Militia and Volunteers was all that could be desired, it would need a long discourse to examine what their place in the field should be in case of war. This much we may say, that it is doubtful whether a single Officer knowing his profession thoroughly, could be found to advocate a passive defence of England. The country is altogether hookwinked on this question. To declare war and keep our regular Army at home would be to give every possible advantage to the enemy, to sacrifice our colonies, to expose the fair fields of England to frequent contamination by the foot of the foreigner, and her people to insult and ignominy. Is there now in this room one Officer, who has really investigated the question, bold enough to stand up and say, that we are prepared as we should be, either for a foreign war or for the defence of the country? We have first-rate soldiers, an excellent system of discipline, and greater harmony between different ranks, than exists in any other Army in the world. Our arms and material are also excellent. But there we stop. We have not yet as much as a Corps-organization even on paper; no General Staff perpetually engaged in improving our organization, and devising means

for making the best of our resources. Our system of supply in peace is quite inapplicable to war, and we have no war-system even on paper. Only three days ago, one of our most talented Control Officers insisted upon this fact in conversation with me. In short, with the terrible example of chivalrous France before our eyes, we are leaving some of our most important preparations to be made on the eve of a war. We are acting as if there never again will be a war in which we shall take part. Yet how absurd is the dream of perpetual peace. We love peace and would do—have done—much to secure it. But I deny that there is a haughtier or more warlike people upon earth. We were within a hair's breadth of war in 1871, and the language of the press, which, better than any other organ, represents the feeling of the nation, is, at this very moment, almost threatening towards one of the greatest military powers in the world.

If then war is possible, what should we soldiers be doing? Surely preparing for combat, not only keeping up a certain number of well-drilled regiments. Let us cease complaining of Parliament and growling at Governments. Every Officer here present has a government of his own, great or small. If each one of us will only administer his department to the best of his ability, we shall have nothing to fear, for the same stuff is in us as was in our forefathers. Some of us love to study the deeds of those who have left us their examples to follow; others endeavour to catch the meaning of present progress, or, with prophetic eye, reach forward to anticipate future developments. With the former let us be conservative of our glorious traditions; with the latter fearless of all necessary changes. Governments are temporary and can do no more than carry out the will of the nation. Who but we ourselves have to tell the nation what military measures it must call upon its Ministers to carry out? The country and the Army are permanent. We have received from our progenitors, and are responsible for transmitting unimpaired to our posterity, the honour, the safety, and the liberties of England.

Mr. De Fonblanque, Deputy-Controller, h. p.: I have no hesitation in being the first to rise on this occasion, because I am quite certain that those who succeed me will have nothing to say but what is in approval of the admirable lecture we have just heard. My remarks unhappily will be, as regards the immediate service with which I am concerned, not exactly in praise. The strictures made upon the Control Department were I think a little hard and severe. I am not an enthusiastic admirer of the form that the Control Department has assumed under War Office manipulation, as I had the honour of stating in a lecture I delivered in this room last year. I then pointed out that there were certain grave defects in the new system; but I think Major Brackenbury has not hit upon the right blots. He has assumed that the individual members of the Department prove themselves wanting in the performance of their duties during the Autumn Manœuvres. (Major Brackenbury: No, no; it is the system, not the individual.) He dwelt upon the fact, for instance, that they were not able to supply the Army without borrowing transport from the artillery. I need hardly mention that that is simply a question of money. If a larger sum had been voted for the purchase of horses, the horses would have been forthcoming; but in the absence of those funds it was necessary to borrow from other Departments, and, accordingly the artillery furnished that supplementary transport, and co-operated most cordially with the Control Department. Again it was stated that they were obliged under all circumstances to supply everything under contract. I do

not think that that was the case. Although all existing contracts were made available, local purchases were resorted to to a very great extent. But the most important point, which I would like to refer to, is the charge of the *imperium in imperio* which is said to exist, and which implies an assertion of independence on the part of Control Officers, which I am quite certain does not exist, and which under a good Commander could not possibly exist, whether he commands a regiment, or a brigade, or a division, or a *corps d'armée* allotted to him; it is utterly impossible for the Control Officer to be otherwise than strictly subordinate and to carry out his orders. Nor do I believe there was a single instance during the Autumn Manœuvres where any Commanding Officer had to complain that a Control Officer under his orders assumed any authority inconsistent with his position as a subordinate. I was very glad to hear that there was no charge intended to be made against individual Officers,—this was it appears a misapprehension on my part,—but I am perfectly sure that that feeling, which was so strongly expressed as to the want of harmony existing between the combatant and the non-combatant branches of the Army, is owing in a very much greater measure to the contempt which the military element has always exhibited (and which existed under the old *régime* as much as now), for men who are civilians serving with the Army, than to any inherent faults of the supply system.

Major-General Shute, C.B.: I do not think it desirable to promote any discussion with reference to the general subject of this most interesting lecture, which has been delivered with the greatest possible tact, and good taste, for we, who were actors in the scenes which have been described, must recollect that, *with wisdom after the events*, it would not have been difficult for so able an Officer as Major Brackenbury to criticise the many errors which must occur even more frequently in peace manœuvres, than in actual war. My chief object, then, in rising is only strongly to advocate, and to give every support, in my power to Major Brackenbury's admirable suggestions with regard to frequent smaller manœuvres, that is to say, such as can be carried out by a single brigade, or even a regiment. It is utterly impossible that without such smaller opportunities of obtaining a knowledge of the rudiments of practical field tactics, Officers in the Army, from Field Officers downwards, can be as well fitted as they should be, to do credit to themselves, and the troops under their command in the larger manœuvres in the autumn, or be as highly qualified, as the times require, for active European warfare. And I wish on this occasion to point out the very great difficulties which Commanding Officers must always experience in their endeavours to conduct these minor manœuvres, consequent on the stringent manner in which the laws of trespass are frequently enforced, and against which the Officers of the Army should, when on duty, have some partial protection; and further, cases of small and unavoidable damages should be fairly assessed and the costs be paid by the War Department. I have long taken great interest in the sort of practice advocated, which I have had sundry opportunities of carrying out, both in India and at home, and both with mixed troops, and with cavalry only, and I can assure, gentlemen present, that my Officers have frequently been grossly insulted, and often rudely driven off ground where for recognizance or other military purposes they have ventured to intrude, and when they could do no possible mischief. On other occasions heavy and unwarranted damages have been threatened. Now, in making these remarks I do not wish to throw censure on such very good fellows as our English farmers generally are, for I feel that it is simply that they rarely understand at first, that the intrusion they object to, is with a view to military instruction and not for mere lark or display, and it may be fairly argued that their objections may very generally be overcome by a little tact and civility on the part of the trespassers, but such is not always the case, and this calls to my recollection a somewhat amusingly overcome difficulty of this nature, which occurred to me little more than a year ago, when I was conducting a manœuvre with one wing of my then regiment against the other, which was occupying a considerable extent of country, and had secured the fords and bridges of about six miles of the Mersey. The farmers in general had shown a rather lively interest in what was going on, but on one farm bordering on the river, the proprietor being absent, was represented by his wife, and I must say that I was somewhat astonished at the strong language which flowed from a young and rather pretty woman, furious at the result of the firing of some dismounted skirmishers; however, I left a plausible good-looking Captain with her, requesting him to remain, and do the

civil, a duty to which he evidently had no objection, and I need hardly add that I heard no more of him for some hours, and when I did next see him he informed me that not only had he overcome all the scruples of this obdurate wife, but that she had desired him to say that she would be glad to see the soldiers on the farm as often as possible! But to be serious, there really are very great difficulties in carrying out these small manœuvres for the reasons I have mentioned, and I feel certain that our able lecturer will agree with me, in the opinion, that an absolute necessity exists for giving some protection to Officers and soldiers, who occasionally leave the high road for either manœuvre or recognizance, as well as funds to meet costs.

General CAVANAGH, R.E : Mr. Chairman, I would simply make one remark with regard to Major Brackenbury's able paper. He has alluded to lines of infantry moving under artillery fire, by which they would have been completely shattered had they advanced in that formation. I think he has omitted to take into consideration as regards the Officers commanding those brigades or regiments, a very great difficulty that exists in peace manœuvres, it is the difficulty of knowing whether artillery is playing upon you. On the last day of the manœuvres I ascertained the range at which one battery was firing : it was 2,000 yards, the object, a small body of cavalry. Supposing I had been in command of that body of cavalry, I should have been perfectly unaware that artillery was firing upon me. Of course we know in actual warfare a Commanding Officer would very soon discover whether he was under the range of artillery, and would at once take vantage ground to cover his men ; but in peace manœuvres it is quite possible that regiments of infantry may be marched steadily on to the front to meet other corps of infantry, and be at the same time entirely ignorant that they are thoroughly enfiladed by distant batteries of artillery. This is one very great difficulty we have to contend with.

Major WEBBER, R.E. : The position of the umpires appears to have been one of the most difficult which could have been occupied during the late manœuvres, and I venture at this meeting to make a suggestion, which, perhaps, our lecturer will endorse—it is this : that instead of our umpires occupying certain areas of ground, they shall in future, invariably accompany different detachments or bodies of troops, whether divisions, brigades, or detached portions of brigades. Because I think one feeling which existed through the armies, both Northern and Southern, was, that after these manœuvres were over, they heard and knew very little of the opinion of those umpires, whom they saw going over the field, and from whom, from time to time, they heard decisions which they did not always understand. I think, Sir, that as the manœuvres are intended as a means of instruction, not only to the senior Officers of the Army, but also to the juniors, and even to the rank and file, the absence of some definite opinion, as to the mistakes and the successes of each day, was also an absence of a means of instruction. Now, if the umpires had on each evening, after they had heard the remarks which His Royal Highness made to them in that charmed circle into which they alone approached—if they had, during those evenings, written down a short summary of what they had seen and heard, then I do not doubt that there were many Officers in the head-quarters' staff of the Army, who would have been willing to have remained up all night even, and to have again summarised those remarks, and prepared for print, a short epitome of each day's operations, with a few real and true statements of success and failures, endorsed by His Royal Highness, which might have been issued from day to day to the troops, so that each one might have had some idea of what he had done well and where he had failed.

Mr. CROOKSHANK, Assistant-Controller : I would just ask one question with reference to what Major Webber has said, and that is, whether umpires can totally dissociate themselves from the sides to which they are attached, and whether there would not be a difficulty in carrying out what he has suggested? I have seen umpires so completely bound up with what is going on on their *own* side, that they drew attention to bodies of troops coming against them. I merely adduce this in support of what Major Webber has said as to the difficulties umpires meet with.

Major BRACKENBURY : I have very little to say concerning what has fallen from the different Officers who have joined in the discussion. I am grateful to General Shute for supporting so warmly what I have very much at heart, and believe to be a most necessary addition to the training of the English Officer and soldier ; that is

to say:—small manœuvres as preparation for the larger Autumn Manœuvres. I had already drawn attention to the point touched upon by General Cavanagh—the difficulty of infantry knowing when artillery are firing at them. There have been different means suggested for obviating that difficulty, and the suggestions have, I believe, been sent forward to the authorities, but as yet all proposals have been rejected. I do not myself quite see how mistakes are to be avoided. The problem is not easy of solution, and there is no doubt, that from the want of some means of informing troops upon whom artillery are firing—now that artillery acts at such long ranges—it frequently happens that guns fire without detection, at their own troops. There was one case, I am told, in which an umpire was sent for in hot haste to put a body of troops out of action. The gentleman who sent for the umpire suddenly discovered that the sufferers were soldiers of the same Army, and, when the umpire came, the conversation was turned. I do not know whether umpires are made of the same stuff as other human beings, but certainly having been myself attached to the umpire staff during the manœuvres of 1871 and 1872, I should say that an umpire working as hard as they have had to do all day, would think it a little severe to be obliged to sit up all night writing a criticism; I entirely agree with Major Webber as to the great benefit which would result, if we could but have some authoritative decision given to us on the results of the day's work, not so much by the umpires day after day, but by higher authority. Do not we all long to have a fair criticism from the highest authority on military questions? Surely nothing would be more conducive to general satisfaction with the manœuvres, or tend more to the contentment of Officers, than to have those questions settled, over which men's minds brood so much now. To Mr. de Fonblanque I have only to say that I had already spoken of the undoubted "energy and ability,"—I believe those were the words—of the Control Officers. The present arrangements are, by general consent, held to be quite unsuited to the supply of an Army in the field, however admirably suited they may be to the supply of an Army in garrison. With regard to any criticisms which may have been made upon the Control Department, or rather upon the want of harmony of action between the Staff and Control Department, it is quite certain that, wherever the fault may lie, they did not succeed in hitting it off together very well. There were occasions (I do not say whose fault it was, but somehow or other it so happened) when there was a serious amount of friction. There were also occasions when the Control Department purchased on the spot, because of the failure of their arrangements with contractors. For instance, once when hay was to have been delivered at a certain place, it was not delivered, for reasons best known to the contractor—and other hay had to be purchased on the spot. There were probably other cases of the same kind. No doubt the "energy and ability" of the Control Officers carried them through such difficulties, and I hope the same energy, the same ability, and the same good feeling which exists both in the Staff and the Control, will bring about an understanding between them, so that the country may be satisfied, that they will manage to work together somehow or another in war. In anything I may have said about the Control Department, I have not spoken without study. My best master has been Mr. de Fonblanque himself, and my text book, his valuable paper read in this theatre last year.

The Chairman: Ladies and Gentlemen. It remains for me to ask you to pass a vote of thanks to Major Brackenbury for the exceedingly interesting lecture which he has given us. In doing so, you will perhaps, excuse me if I make a few observations upon what has passed this evening. First of all, I think Major Brackenbury made a very valuable suggestion when he threw out the idea that the manœuvres might be conducted in a more satisfactory and instructive manner, by giving two corps, opposed to each other, particular lines of communication and allowing them to work very freely, consistently with maintaining those lines of communication with their supports or reserves, whether real or supposed, behind them. I think that the result of such liberty of action would be a more decisive test of the Control Department, the effective working of which is one of the moot questions of the present day, and has such an important bearing on the organisation and administration of the Army. It appears to me that it is unfair upon the Control, to expect them to carry, for peace manœuvres, the large amount of stores which are required to prevent injury and unnecessary suffering on the part of the troops engaged, and

which would never be attempted to be carried in war. For instance, tents are things now which in war it is quite out of the question to think of carrying with an army; they are very bulky, and heavy, and absorb a great deal of transport. Then again with regard to hay and forage, I think in most countries cavalry would have to keep themselves to a very large extent, that bulky and weighty articles of that nature cannot possibly be carried for the supply of large bodies of cavalry. But I can see no reason whatever, why a system of requisition may not be adopted to a certain extent, even in peace manœuvres, by the Control having within the theatre of the proposed operations, depôts of hay and forage, not necessarily purchased, but contracts for their purchase made, upon which, if necessary, the troops may make requisitions in the same manner as they would if they were working in a hostile country. I think that by a few arrangements of that sort, we might reduce the transport required for the Control, and the various duties, not only of transport but of baking bread, and many others, might be reduced more approximately to that practical shape they would assume in war. Major Brackenbury's recommendation, respecting which General Shute has spoken, that small manœuvres should be practised in the interval between the Autumn Manœuvres, is one of the greatest importance to the welfare of the Army. But the difficulties to which General Shute has alluded are undoubtedly very serious: I myself constantly see troops on the line of march with small advanced guards in front of them, that cannot send out a feeler on either side. They make long marches through narrow roads with hedges on either side and woods close to them; they cannot send out a man to look about them and protect their flanks. Those marches so conducted, in my humble opinion, positively do harm, because they teach soldiers what is totally inconsistent with warfare. If they are mere exercises to keep the men and horses in a good state of health let them be considered so, but they should not assume the mock appearance of an operation of war. Well then, gentlemen, with regard to these small manœuvres, I would venture to recommend that they should be carried a step further than has been recommended by my friend Major Brackenbury; I think the Staff want small manœuvres just as much as the troops. Some years ago, I had an opportunity in a foreign country, of seeing the work of a number of Staff Officers of all arms, who were sent out under a superior Officer selected for the especial purpose. They were accompanied by a few orderlies and went through a series of sham manœuvres on the ground which had a practical object, that object being no less than to determine the course that should be taken in case that country should be attacked upon a particular frontier. They manœuvred over that country, the Officers representing the Staff Officers of brigades, divisions, and corps. They examined the whole district, working upon a sound military basis, as devised by the superior Officer in command. The operations took some three weeks or a month, at the end of which the Officers all met, the country being fresh in their minds, having sketched amongst them the greater part of the best military positions; and discussed the defence of the adjoining frontier; the result was an admirable plan for its defence, drawn up and placed in the archives of the Ministry of War, in which the most important strategical and tactical positions were pointed out; the Officers who surveyed those positions afterwards drew up a memoir on their defence, accompanied by detailed plans, which were all placed in the archives of the Ministry of War, and in case of war could be handed to any railway contractor or person accustomed to organise labour; these works could thus be constructed independently of the Army, by the population of the country, and would add enormously to the defence of that frontier. Manœuvres of this character, which I had the honour some years ago to submit to the authorities as most desirable, are in fact, a sort of *kriegsspiel* in the field. We have all taken great interest in the *kriegsspiel*, it occupies a great deal of our attention, and if supplemented by manœuvres such as I venture to propose, in addition to those suggested by Major Brackenbury, would, I think, be attended with the greatest possible advantage to the Army; the Staff would learn to work together, to know each other well, to know the face of the country and its resources, the railroads, and the best means for utilizing and destroying them, as also other communications, and would in fact, become thoroughly aware of the intricacies of our own country, and would then be in a position to give the soundest possible advice as to the measures which should be taken for its defence.

I perfectly agree with Major Brackenbury, that any defence to be sound should not be passive but active, but the practice we should thus obtain in our own country of considering these questions, is precisely that which we should require in a foreign country. I think if the Staff were thus educated, there would be more certainty in the selection of Officers for Staff employment in war, and that they would very rapidly bring about a very different state of things throughout the whole Army. They would not hesitate in that case to make their observations freely and fully, and submit them to discussion, and thus get over that difficulty which has been suggested by Major Webber, of the observations made at the Autumn Manœuvres, not being known to Officers of the Army generally. I ask you to give your best thanks to Major Brackenbury for his most interesting lecture.

Evening Meeting.

Monday, February 3rd, 1873.

Admiral GEORGE ELLIOT, in the Chair.

NAMES of MEMBERS who joined the Institution between the 28th January and the 3rd February, 1873.

LIFE.

Percy, Lord Algernon, M.A., Lieut. Grenadier Guards.

ANNUAL.

Braddock, Lionel F., Capt. 1st Surrey Artillery Volunteers.
Falwasser, Ernest B., Ensign 22nd Middlesex Rifle Volunteers.
Trench, Fredk., Capt. 20th Hussars, F.R.G.S.
Legge, Hon. Henry C., Lieut. Coldstream Guards.
Browne, W. H., Lieut. Bengal Staff Corps.
Anderson, J., Lieut. London Scottish Rifle Volunteers.
Archer, R. H., Lieut. R.N.
Harris George, Captain R.E.
Cookesley, E. M., Capt. late 22nd Regt.
Verity, C. F., Capt. 2nd Middlesex Rifle Volunteers.
Bingham, R., Lieut. R.N.
Crommelin, W. A., Colonel R.E.

LOWERING BOATS AT SEA.

By W. Stirling Lacon, Esq.

In consequence of the accident involving loss of life which happened to the boats of Her Majesty's ship "Ariadne," in 1872, the subject was taken up in the House of Commons, and after debate, and strong expression of opinion by various Members, on the motion of Mr. Bouverie, the question was referred to the Lords Commissioners of the Admiralty, who "decided to appoint a Committee to inquire into the "question of the supply of life-boats to the Navy, the best lowering "apparatus adapted to the special services which men-of-war have to "perform, and generally into the best means of saving life at sea, "always bearing in mind the special character of Her Majesty's ships." The scope of the enquiry being thus limited (although two out of seven members of the Committee were appointed from the Merchant Service), the Committee reported upon the three plans which have been in use, or tried in Her Majesty's Navy—namely, Clifford's, Kynaston's, and the ordinary service plan. With regard to Clifford's, the report says, "Many failures, due to the apparatus, have occurred in lowering boats so fitted, and the Committee are therefore unable to recommend its adoption in Her Majesty's Navy." With regard to Kynaston's, the report says, "Though

" there are some instances recorded in which they have not acted satis-" factorily, still they so nearly meet the conditions required, that the " Committee feel justified in recommending their further supply to Her " Majesty's ships. At the same time they are unable to recommend " their use being made compulsory on Officers who are unwilling to " adopt them." And as to the ordinary service plan, the report says, " The evidence does not record *the loss of a single life to Her Majesty's* " *Service attributable to this fitting*,* although the witnesses examined " must have referred to an experience of many hundred instances of " its use at sea. It possesses the advantage of simplicity, and enjoys " the entire confidence of many experienced Officers, whose judgment " is supported by the large success which has attended its use—a fact " confirmed by the evidence; the Committee are therefore of opinion " that this is the most satisfactory mode extant of lowering boats at " sea." And further, " The Committee cannot recommend any of the " inventions for lowering boats at sea by mechanical means, which have " been brought before them."

Having twice lectured at this Institution on this question, and having for the last twenty years endeavoured to direct public attention to the subject, I appeared, and gave evidence before this Committee. But a gallant Admiral writes to me, " Your evidence is so given in the Blue Book, that it is impossible to make out what you mean." And it is so. I saw (I think I may say so) that there was but little disposition to accept the information which I was desirous of putting before the Committee, and the drawings which I was requested to send in, were not published with the others, but were handed over to the Admiralty, when the Committee broke up. The Admiralty have since deposited them in this Institution at my request.

I was desirous of recording information that might be useful to the public *generally*, but I was told " that the Committee wished to con-" fine themselves to the Navy." But I could have given information that might be useful to the Navy, had I been so permitted. The report of the Committee says, that " the last accident appears to have been " in 1835, to Her Majesty's ship 'Melville,' off the Cape of Good " Hope, in bad weather, when both cutters *were lowered successfully* " by common tackles for the rescue of an Officer and man overboard." But the following stands recorded in the *Journal* of this Institution:— Before the delivery of my lecture here on June 9th, 1858, I wrote to General Willes for the particulars of this melancholy case, he having been on board at the time, and he enclosed to me the following letter from Captain A. S. Hammond, R.N.:—" On the occasion of Sir John Gore's " son being drowned off the Cape of Good Hope on the 30th of April, " 1835, the 'Melville,' 74 guns, on board of which ship the Admiral's " flag was flying, was lying to, under a maintop-sail. The courses " were being hauled up, and topsails lowered on the cap, with yards " braced in and secured. A man having fallen overboard from the " weather foreyard-arm, Lieutenant John Gore, the flag lieutenant, " jumped overboard to save him from the weather-quarter boat; and " soon afterwards the lee-quarter boat was cleared away and lowered,

* The italics are mine.—W. S. L.

" with Lieutenant Fitzgerald and ten men in her, at which operation I " attended. But in spite of every attention, from the heavy lurching " of the ship, and her rolling to windward, a considerable quantity of " water was shipped by her; and I am also of opinion that the boat was " shaken by the blows which she received in striking against the ship's " side in the act of lowering. In consequence of this impression, I " spoke to the Captain (the present Rear-Admiral Sir Henry Hart, " K.C.B.), and asked him if I might be allowed to take the weather " quarter cutter, in case of any disaster having happened to the other " boat, to which request he gave his consent, and I jumped into her, " quickly followed by numerous volunteers, and a young middy of the " name of Heath."

Gentlemen, I must here be allowed to pause. I also was a midshipman in those days, and I dined on board the "Melville" at Saugor, and sat at the same table with Lieutenant Gore, and probably saw many of the unfortunate men who were drowned; the other middy was the present gallant Admiral Sir Leopold Heath, the Senior Naval Officer of the Abyssinian Expedition.

The letter goes on to say—

" Any amelioration of the established plan of lowering boats would, " in this instance, have been of infinite service: for I have never " witnessed a worse occasion for lowering a boat during my experience " at sea. From the weight of the men in her, and the constant lurching " of the ship, we were nearly thrown out of the boat frequently, and I " thought she would have been stove in from striking against the " muzzles of the main deck guns; and before we could get the tackles " unhooked, the indraught took us under the counter, and we had the " nearest escape possible from being swamped by it. Fortunately we " managed to get clear of the ship without mishap, and proceeded on " our search, which proved, alas! a most fruitless one, as all hands were " lost except ourselves. Don't you recollect," continues the writer, " when a man fell overboard from us, just after leaving the Sand-" Heads, and a quarter boat was lowered with, I think, Crawfurd in " her, and the boat's crew, and something happened to the boat's tackle-" falls in lowering, and the whole of the men were thrown into the " water, and they also went astern, together with the swamped boat, " oars, bottom boards, &c., floating about. Fortunately no lives were " lost, but there might have been."

I quote again from the Journal of this Institution:—

" On Saturday, the 20th of November, 1804, the English fleet, under " the command of Admiral the Honourable W. Cornwallis, lay at " anchor in Torbay; as it was late in the year, and the night dark and " stormy, orders were given for the fleet to put to sea. Unfortunately " in fishing the anchor of the 'Venerable,' 74 guns, the fish hook " gave way, and a man was precipitated into the sea. The alarm was " immediately given, and one of the cutters was ordered to be lowered. " Numbers of the crew rushed aft to carry the orders into effect; but " in the confusion one of the falls was suddenly let go, the boat fell by " the run, filled, and a midshipman and two of the men were drowned. " In a few minutes another boat was lowered, which fortunately suc-

"ceeded in picking up the man who first fell overboard. Owing to "this delay, the 'Venerable' fell off considerably towards Brixham, "and getting stern way, was unable to weather the Berry Head. "Every effort was made to stay her, but the ship refused; and not "having room to wear, she drove on shore at the north part of the bay, "on a spot called Roundem Head, near Paignton. In sixteen hours "from the time she first struck, the whole vessel had disappeared "under the action of the raging surf, lashed into fury by the violence "of the gale. The crew consisted of 590, of whom a few were "drowned."

Again,—

"The 'Avenger,' a steam frigate, Captain Charles Napier, with an "armament of six heavy guns and a crew of 250 men, sailed from "Gibraltar on the 17th of December, 1847. At 9 P.M. on the 20th of "December, while running with square yards at the rate of eight or "nine knots, she struck upon the Sorelli. The officers in the gun-room "were upon the point of retiring to their berths when they were startled "by a sudden jerk; the ship gave a heavy lurch, as if filling, and her "whole frame appeared shaken, and every beam loosened. The "Captain then gave the order 'out boats;' these were his last words, "for he was immediately afterwards washed overboard and drowned. "Whilst they were in the act of lowering the cutter, an accident "occurred which was nearly proving fatal to all their hopes of preser-"vation; in lowering the boat, the foremost fall got jammed, and the "after one going freely, the boat had her stern in the water and her "bows in the air. At this moment Dr. Steel threw in his cloak, "which fortunately got into the sheave-hole of the after fall and stopped "it. Just as the boat touched the water, and before the tackles were "unhooked, the ship again struck heavily, and began swinging broad-"side to the sea, falling over to starboard at the same time, which, "from the cutter being the port one, made her crash with great violence "against the ship's side. However, by dint of great exertion, the boat "was got clear from the tackles, and pulled clear from the ship. Of a "crew of 250, 246 were drowned."

The report of the Committee states "the evidence is remarkable for "establishing the fact that comparatively few accidents involving loss "of life have occurred in Her Majesty's Navy to boats lowered at sea." How far this report may be satisfactory to the House of Commons, by whom the inquiry was instigated, remains to be seen. I can only regret that two of the Members of the Committee were unavoidably absent the day I gave my evidence, namely, the Duke of Edinburgh and Sir James Anderson. Of His Royal Highness it would be presumption in me to speak; but the man who conducted the brilliant enterprise of picking up the Atlantic cable, an exploit worthy of the genius of a great maritime country, is not the man to shelve any question that might be useful to the profession of which he is so distinguished a member.

Before passing on, I must be permitted to give opinions and facts other than those appertaining to the Navy, with regard to a system, an amelioration of which the House of Commons has expressed itself so

desirous of obtaining. The following is recorded by the Religious Tract Society, after the loss of the "Kent" by fire in the Bay of Biscay :—

"Although Captain Cobb had used every precaution to diminish "the danger of the boat's descent by stationing a man with an axe to "cut away the tackle from either extremity, should the slightest diffi-"culty occur in unhooking it; yet the peril attending the whole "operation, which can only be estimated by nautical men, had very "nearly proved fatal to its numerous inmates. After one or two "unsuccessful attempts to place the little frail bark fairly upon the "surface of the water, the command was given to unhook. The tackle "at the stern was, in consequence, immediately cleared; but the ropes "at the bow having got foul, the sailor there found it impossible to "obey the order. In vain was the axe applied to the entangled tackle, "the moment was inconceivably critical, as the boat, which necessarily "followed the motion of the ship, was gradually rising out of the "water, and must in another instant have been hanging perpendicularly "by the bow, and its helpless passengers launched into the deep, had "not a most providential wave suddenly struck and lifted up the stern, "so as to enable the seaman to release the tackle."

In the case of the Royal Mail steamship "Amazon," one of the survivors states :—

"The mail boat, when lowered, was immediately swamped with about "twenty-five people in her, all of whom were lost. The pinnace, when "lowered, sheered across the sea before the people in her could unhook "the fore tackle; they were thereby washed out, and the boat remained "hanging by the bow. While clearing away the second cutter, a sea "struck her and raised her off the cranes, and unhooked the bow "tackle. The fore end immediately fell down, and the people in her "(with the exception of two, who hung doubled over the thwarts), were "precipitated into the sea."

Lieutenant Grylls, R.N., stated :—

"The first boat attempted to be lowered was on the port quarter. "Lieutenant Grylls was himself lowering the after-fall, when Captain "Symons seized him by the arm, and besought him to desist, as he said "everybody would be drowned. Lieutenant Grylls then called out to "the person by the foremost fall, imploring him not to lower, as the ship "was going so fast. The person at the foremost fall, by constant and "urgent request of the people in the boat, let the fall go, by which "means the boat turned over, and, as nearly as could be seen, every one "was washed out of her. Seeing this at the moment, Lieutenant "Grylls attempted to let go the after-fall, so as to save them; but the "fall being jambed, and having fouled, and the boat thus not being "clear, her stern hung in the air for the moment, until cut adrift by "some one, when she turned over, and, seeing the people washed "away, Lieutenant Grylls turned aside from the appalling sight in "horror."

Mr. Neilson states :—

"In the meantime, the aftermost boat on the port side (I think the "mail boat) was lowered down, with probably twenty-five people in "her; but the moment she touched the water she swamped, and all

"hands that were in her drifted astern, all clinging together with "dreadful shrieks. The next boat forward (the pinnace) was also "lowered full, but by some accident the after tackle alone got unhooked, "and she was dragged forward by the foretackle with such rapidity "that the sea swept round her sides, and washed every soul out of her. "At this time the second cutter had reached the water, when a sea "struck the bow, and as the ship rose from the swell of the waves, she "lifted the boat perpendicularly by the stern tackle, and discharged "all the unfortunate inmates but two, who hung shrieking across the "thwarts."

William Angus says:—

"In attempting to lower another boat on the starboard side (the first "cutter), the stern fall was let go too quickly, and on dipping into the "water, the boat was drawn to the side of the ship, and the people "thrown into the sea."

Isaac Roberts stated:—

"In lowering her down, unfortunately he let go the fore tackle, and "threw the people, about eighteen or twenty, crew and passengers, into "the water."

George Webb says:—

"The Chief Officer, and several others, were clearing away the after- "most lifeboat. He jumped into her, and got hold of the tackle, and "lowered her down. Some one else lowered the bow. Before the boat "touched the water, the after tackle fouled, and he took out his knife "and cut it."

Henry Wright says:—

"When in the boat, preventing her from being swamped by trying "to clear the fore tackle fall, the block caught his left hand, and took "off the tops of his two middle fingers, and smashed his little finger;" and Alexander Lang, quartermaster, says "that he went to the wheel, "but it was fouled by the tackle fall of the dingy."

It was a terrible visitation; this ship on fire, in a dark night, gale of wind, and tempestuous sea, *tearing along at full speed*, without their being able to stop her, and dragging her miserable crew to destruction, and among them the accomplished author of "The Crescent and the Cross;" but "the Committee entertain grave doubts whether, however admirable "the lowering and disengaging apparatus may be, it is wise to man "and lower a boat in any considerable sea, *while the ship is rapidly* "*advancing through the water*."* But time and tide will wait for no man, nor will the progress of events stand still in order to keep pace with the minds of the Committee. No man in his senses would lower a boat at *full speed*, if it could be avoided; but if a boat can be lowered safely at *full speed*, it is evident that she could be lowered safely under other circumstances. Other cases might be quoted, such as the loss of the "Orion" on a fine summer's evening, off the coast of Scotland, where, "while lowering the starboard quarter boat, the bows were "down in the water, while the other end hung by the tackle, and one "or two tumbled out of her; and while the port lifeboat was being "lowered, there were one or two tumbled out of her." Or, in the

* The italics are mine.—W. S. L.

wreck of the "Conqueror," near Boulogne, where "the ladies, children, "and servants were handed into the cutter; the water was not a couple "of yards off her bottom, but the falls of the tackle had got so entangled "with the rest of the cordage on the poop, that they were not able to "lower them. The Captain cut the boats from the davits."

When I had the honour of conducting the Crown Prince of Prussia over this Institution, he did not seem to be so much impressed with the arms or models, as with this theatre. He said, "Ah, there is the value of your Institution." It is a fortunate thing for this country that there is some place where such things as I have detailed may be made known. That such things are of the deepest interest to the great steamship companies and the travelling public, I will quote from the lately published work of an American gentleman, "Around the World by Dr. Prime." He says, speaking of the Pacific Mail Steam Company's ship "Japan," 4,351 tons, between San Francisco and Japan and China:—

"The ship carries thirteen large lifeboats, all ready for launching, "each one capable of floating some fifty persons or more; but it adds "very little, to my sense of security, to see this array of lifeboats. In "those sudden emergencies, which constitute the chief dangers of the "sea, it is seldom that they are successfully launched, or prove of any "essential service to the mass of the passengers."

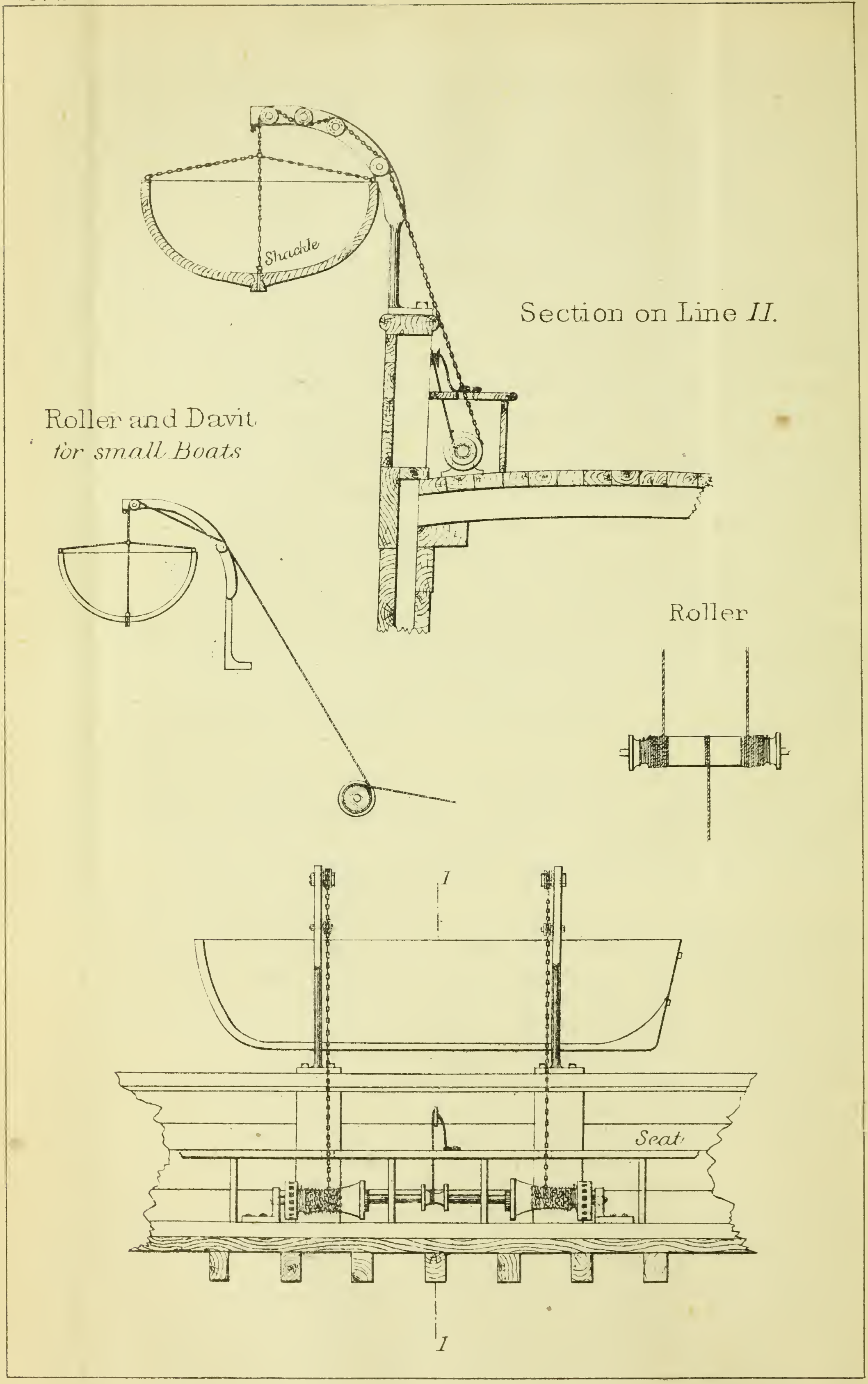
The evidence I have adduced, and the labours of men who for years past have endeavoured to procure an amelioration of the present system (a list of those who have deposited their plans in this Institution is given at the end of this paper) are sufficient proof of the dangers attending "this ordinary service plan." In using these tackles, it requires two men in the boat, one at each fall to unhook, and on board the ship, two men to lower and two men to clear the falls, no easy matter where the falls are little used, and where, as in the case of the largest merchant steamers, each fall is 22 fathoms, or 132 feet long (the davits of the "Princess Royal" are 45 feet from the water, consequently the falls must be five or six times that length, or at least from 230 to 270 feet long). Under any circumstances it requires the greatest unanimity of action on the part of these six men; but how is this to be insured during periods of excitement and danger, and during dark nights? If one of the falls should be lowered too quickly,—if one of them should foul, or be accidentally let go, then one end of the boat having reached the water before the other, it is impossible for the men in the boat to unhook at the same time, and an accident must inevitably happen. Or, supposing that all has gone right on board the ship, and that before the boat has reached the water a sea should lift the stern of the boat and unhook the after tackle, then the boat would sheer across the sea before the people in her could unhook the fore tackle, and they would thereby be washed out, and the boat would remain hanging by the bow; or, if in the act of lowering, a sea should strike the bow and unhook the fore tackle, then the fore end would immediately fall down, and the people be precipitated into the sea and drowned. Not only is this operation of lowering boats attended with so much difficulty and danger, but it is an extraordinary fact that it is in direct opposition to

any mechanical operation of the like character. It is an acknowledged principle of mechanics that to raise a weight requires a power; but what is gained in power is lost in time. We see it in the every-day operations of raising a weight, that when the weight has attained the requisite elevation, the power is disconnected, and a break, or other analogous contrivance, is substituted, in order to regulate the descent. Why, therefore, should not the same plan be adopted in the case of weights (*i.e.*, boats) which remain for a lengthened period at the requisite elevation, and which are only required on sudden emergencies? Sailors themselves acknowledge the principle, and carry it into effect, as in the case of the anchor. When the anchor has been elevated by means of the chain and capstan to the level of the water, a tackle called the "cat" is used to raise it to the level of the deck; this is the power, and sailors know very well that if they were to allow the same to remain, the anchor could never be used on sudden emergencies; they therefore substitute a single rope or chain (called the cathead stopper) and remove the tackle. They remove the one tackle from the anchor; why, therefore, should they not remove the two tackles from the boats, which it has been shown in their use require the greatest unanimity of action? Many Captains of ships have acknowledged the principle, even in the case of boats, for they have unhooked the tackles and substituted single ropes or pennants; but in doing so, they have aggravated the disease without substituting a remedy, for, it must be apparent to every one, that if, in lowering with the tackles, there was danger of a heavy boat going down by the run, that danger must be considerably enhanced where the weight has to be balanced and controlled by a single rope.

(I see many landsmen present; I must tell them that sailors are very funny fellows, and have a language of their own. They first cat the anchor, and then they fish it; still Jack is a character we should do well to cultivate, for England may rue the day when she turns her sailors into stokers and pokers.)

Through the press I have stated as follows:—"A screw steamship "shall be fitted with four boats on either side of her, and I will under-"take, with one man stationed at each boat, to put all of them, full or "empty, safely and securely into the water, within one minute of the "order being given to lower, *the ship going at full speed*." If this is no mere theory or vain boasting, then it will be seen how valuable such an instantaneous system must be in these days of monster ironclads, which, if they do go down, will probably, like the "Captain," go down like a stone, or to the light armour-clad ship, which may be sunk by a shot from one of the monster guns now adopted.

Twenty years ago, the plan which follows was fitted to two of the South Eastern Company's steamers at Folkestone, and in the presence of several thousand people, I, accompanied each time by four men, was lowered six times, *the ship going at full speed*, or at the rate of $12\frac{1}{2}$ knots an hour. A certificate, signed by Admiral Sir Edward Tucker, Admiral Hathorn, and twelve other nautical men, testifying to the perfect success of the experiments, was forwarded at the time to the Admiralty; but although, according to the Committee's report, "they have had


Shackle
Section on Line II.
Roller and Davit
for small Boats
Roller
I
Seat
I

J. Jobbins

"access to and have examined all the records existing at the Admiralty "since the commencement of 1852, which bear on the questions "referred to them," they have not considered a plan where such results have been obtained worthy of any other fate than being stowed away at the Admiralty, to be out of sight and out of mind.

I will now describe the plan, of which the engraving on the opposite page is a representation.

The Boat.

Eye-bolts are driven through the keel, at the bow and stern, and are clinched. The position of these two eye-bolts will determine the distance apart of the two davits, and the two outer drums to be hereafter mentioned. If the boats are intended to be swung inboard, the eye-bolts must be near the bow and stern of the boat; if not, then they may be nearer towards the centre of the boat.

The Chains or Rope Pennants.

At one end of each rope pennant or chain is a shackle to attach them to the two eyebolts. Just above the thwarts two smaller chains lead from the main chains, and are attached or hooked to each gunwale to prevent the boat from canting, and at the other end of each chain or pennant is spliced on a length of about 25 feet of lead line with an eye at either end.

The Davits.

At the outer end of each davit is an eye-bolt for hooking on the tackles, and in the davits three sheaves, one over or before the other. (If on experiment three sheaves should not be found to be sufficient to control the descent of the heaviest boat, then five, or the pulleys or sheaves must be placed closer together.)

The Roller or Drums.

On board the ship is a roller, or three drums attached to each other by an iron bar. To the centre drum, and round which it is coiled, is attached a rope. On one end of each of the outer drums is a groove for receiving the small lines before-mentioned, and a pin on which the eye at the end of each line is to be placed.

When the boat has been hoisted up by the tackles, the ends of the lead lines are passed over and under the sheaves alternately in the davits, and brought inboard and placed over the pins on the drums. By gently pulling upon the centre rope, the drums are made to revolve, the lead lines are coiled in the grooves for their reception, and the chains or pennants packed upon the two outer drums. When the whole has been hove in and set taut, the centre rope is belayed round a belaying pin or cleat, the tackles are unhooked, and the boat is stowed.

The roller or drums may now be boxed in, or, as was done in the case of the South Eastern Company's steamship "Princess Clementine," covered over with a seat for the passengers. It is worthy of remark that one pair of tackles would be sufficient for all the boats, and these may be kept below, free from the influence of the weather.

In the drawings, the two outer drums are capstan-headed; this is not necessary for lowering, but on board the "Princess Clementine," two men hoisted up the boat by means of handspikes without the intervention of tackles.

Care must be taken that the chains or pennants shall be too long, rather than too short, making plenty of allowance for the light and deep draught of a merchant ship.

Lowering.

One man at the centre rope lowers, and, being on board the ship, can watch the opportune moment to drop the boat into the water. If the boat is lying quietly alongside, the chains or pennants are lowered into the boat by means of the lead lines. If the ship has way on her, the boat will drag away the chains, and they will fall harmlessly into the water. They can now be drawn into the boat, where they will act as ballast; or if the boat is going away for any length of time, they can be unshackled and left on board the ship. In merchant ships, where the boats hang from the davits for a lengthened period, the use of chains instead of ropes would avoid the necessity of freshening the nip.

I regret that time will not enable me to allude to the various plans which have been brought forward from time to time for "lowering boats at sea," showing at least how much it is a want that is felt by the public; but as my opinion was asked by the Committee with regard to Clifford's and Kynaston's, I may say that, twelve years ago, I brought forward Clifford's plan in this Institution, because I was desirous that the public should have some amelioration of the present most dangerous system; but there are these disadvantages attending Clifford's system, the man lowering being in the boat cannot see what he is doing, and very likely lets go into the trough of the sea at the very moment when he should not do so, and the boat itself must be disabled by the heavy roller which is in her. Kynaston's plan does not do away with the very objectionable method of lowering by the tackles, although a Lieutenant told me that he would not use the tackles. I asked him what he meant? He said he should wait till the ship rolled, and then drop the boat on to a sea from the davits. Whether the lifeboat of Her Majesty's ship "Serapis" had her bottom knocked in by this method, I am unable to say.

With regard to the "Challenger," her boat was fitted with Mr. Hill's plan, and Neptune did for them what the smart Lieutenant proposed to do with Kynaston's,—a sea struck the bottom of the boat, and disengaged her, whereby she was lost to the "Challenger," and to Her Majesty's service. Admiral Richards has written to me that this was through no fault of the system, and I believe the inventor claims it, as showing the merit of his plan.

The following plans for lowering boats at sea have been deposited in this Institution, where they may at any time be consulted by persons desirous of obtaining information on the subject:—

Lacon's (1852)	..	Journal of the Institution, pamphlet and plan.
Clifford's (1857)	..	Journal of the Institution, pamphlet and model.
Kynaston's	..	Pamphlet.
Russell's ..	..	Model.
Simpson's	..	Model.
Kilner's ..	..	Model.
Hill's ..	..	Journal.

Gentlemen, you must form your own conclusions from what you have seen and heard. What I wish further to put before you, points the moral of my tale.

The following is taken from the Journal of this Institution, August, 1866; it is an extra number, devoted entirely to "The Loss of Life at Sea," in order that the attention of the authorities and of the public might be directed towards it. In February, 1853, the *Times*, in a leading article, says:—"As the 'Queen Victoria' was lying in the "Liverpool Docks last July a gentleman, competent to observe such "matters," (and when I mention that he is a member of the Council of this Institution I think it will entitle him to a favourable consideration at your hands), "noticed that her boats were indeed sound and "spacious, but that they were enveloped in strong canvas, painted "black, and actually laced below the bottom of the boat, while "the machinery for lowering them was so defective as to be "virtually unserviceable. So absolute indeed was the default of "any proper precautions against sudden accident, that the observer "called one of the seamen to him and pointed out the circumstances, "and remarked that the day might come when this inattention to ap-"parently small particulars might cost many lives. That day did "come (within six months), and the lives have been sacrificed accord-"ingly." "The morning was fine and the water smooth. The two "life-boats, which ought to have saved so many, appear to have gone "down with the vessel." (They were not disengaged from her till sixteen hours after the accident.) "The result is that the lives of "*fifty-nine persons*, including the unfortunate Captain, have been sacri-"ficed."

Of the recent terrible calamity (I refer to the loss of the "Northfleet"), I wish to say but few words. The heart of the country has been profoundly stirred, and no words of mine could paint the horrors on the deck of that ill-fated ship during that awful night. But I must point out to you that the ship was lying at anchor, surrounded by other vessels, and the shore-lights at hand; the water was comparatively smooth, and an interval of three-quarters of an hour intervened between the time of the collision and her going down; but of all her boats two only were available, and of these two, one was stove in, and the other cut from the davits; yet this ship was fresh from Board of Trade inspection, the Emigration Commissioners having very recently been superseded by the Board of Trade.

You have seen how this plan which I have submitted to you was treated at the Admiralty. The Emigration Commissioners refused to

see it. I offered to submit it to the Board of Trade, or to any persons to be deputed by them; they also declined even to look at it. My only object is to make it available for the benefit of the public.

Captain Wells, R.N.: I should like, Sir, to offer a few remarks upon this lecture which has been an interesting one, and to which we have all, I am sure, listened with a great deal of attention. But at the same time certain remarks were made about the Committee which, to a great extent were, I think, undeserved. The naval members of that Committee are most distinguished Officers and thoroughly known and appreciated by the whole of the Service, and I need not say that the two mercantile Officers are equally distinguished in their relative positions. We have seen Mr. Stirling Lacon's model, and no doubt it works very quickly as a model. But the objections which I have to offer to the contrivance are these. In the first place, if the pennants were worked with chains instead of ropes, I for one should decline to go in the boat at all. In the next place, if the vessel was going through the water (when we know the length of that pennant must be at least 40 feet, the poop of a line-of-battle ship being some 26 feet above the water, must allow for the length of the davit), I have some doubt in my own mind when the boat was shoved away from the side of the ship, if we should not have the end of the pennant in the screw-well. Another remark I have to offer is this. It is proposed to have a number of sheaves in the head of the davit to take the nip of the pennant. Now, although the objection to the chain is quite established in my mind, still, having it rope would be also objectionable, inasmuch as rope is liable to swell; and in the next place, we know what a dead nip is, and the great objection which all naval Officers have made to Clifford's apparatus is, that very dead nip, and the single pennant. I have seen Clifford's apparatus and Kynaston's, as well as the old fashioned plan we have in the Service. I have constantly tried them, and I have been lowered both by Kynaston's and Clifford's apparatus myself, and on one, if not two or three occasions, with Clifford's apparatus after rainy weather; the rope having been made of softened hemp, was found to have swelled tremendously. On the other hand, the objection to the Kynaston's plan is the manner of freeing, which the man has to do in the boat, and as I have seen myself, the boat has been suddenly freed six feet above the water. This invention of course would free itself from the davits, provided it rendered, which I think somewhat doubtful, at all times; however, if it is rope, and does render, some of the boat's crew would have possibly a very severe blow, not to mention the fouling of the oars. The model works very well and very prettily, but whether the plan would work with a heavy line-of-battle ship's or one of the iron-clad's cutters and 14 men in it, is, I think, somewhat doubtful; at least I should like to see it verified before I would allow it. I think the objections which I have raised to the plan have some weight. It certainly has all the faults but one of that of Clifford, and I think it has an extra one of its own, which to my mind would be impossible to overcome.

Colonel Strange: May I ask whether this plan has been tried in the Royal Navy?

Captain Wells: It has not to my knowledge.

Captain Balfour, R.N.: I feel diffident about saying anything, but I hardly understand that principle of lowering, whether it is in the way of Clifford's or not; but from what I understand, those pennants are rove in the boat, and they are brought on board and require a certain degree of manipulation, and that one man in the boat cannot let go the apparatus at once. I do not know whether I am right?

Mr. Stirling Lacon: It is let go on board the ship, and not in the boat at all.

Captain Balfour: The principle to be desired is, that the boat should be relieved when she touches the water. In Clifford's plan I think you cannot relieve the boat till she sheers. I do not know much about Kynaston's plan, but it has a quantity of gear, and you do not relieve the boat at once. I have a plan of my own, which I am sorry I cannot bring forward in the short time allowed to me to-night. That plan is, that directly the boat touches the water, she is relieved without all that supernumerary gear, with the old tackle and fall, and without any gear but what

is contained in the bottom of the boat. I hope I shall be able to bring the whole thing before you very shortly.

Captain Fremantle, R.N.: One thing, I think, has been made exceedingly clear, namely, that it is easier to destroy than to construct. I have seen Clifford's and Kynaston's, and we have now had Mr. Stirling Lacon's plan described to us; at the same time I am not at all inclined to give up the idea of obtaining something very superior to the present Service plan. I quite agree with Mr. Stirling Lacon in what he said as to the question of lowering, but I think he rather understated the case. He said for instance, we must have two men in the boat, two men lowering the falls, and two men seeing the falls clear, and that makes six men. Now everybody is perfectly aware that at least there must be a seventh to secure anything like safe lowering, and that is the most important of all, the Officer or man who sees to the boat being lowered, who is looking over the side and says, "Hold on the after fall," and so on. Under those circumstances I think we certainly should not stop short of some system which is superior to that, and I venture to think Mr. Stirling Lacon is also perfectly right in the view which he takes, which is that something better for lowering must be had than the boat's falls. I think that is a *sine quâ non.* I think, amongst the dangers and accidents which have happened in lowering boats, the most fertile of those dangers is the jambing of one of the falls. I think it is quite unnecessary for me to mention that, to an Officer who can give such a good opinion on the subject as no doubt you will yourself, Sir (referring to the Chairman). That is then one thing which we must guard against. Viewed from that stand point, I must confess the praise which has been lavished upon Kynaston's is, to my judgment, rather undeserved. If the fall jambs, Kynaston's is a failure; therefore, if it be a necessity that we should have something which does not lower by the falls, why we must put Kynaston's out of court. Then we come to arrangements such as Clifford's and Mr. Stirling Lacon's. Now I am afraid Mr. Lacon's was pretty well cut up, to use the common expression, by Captain Wells. Captain Wells mentioned several objections, but an additional one occurs to me, and that is, that in unreeving the small lead-line which has to pass round several sheaves, the probability is the small lead-line will jamb between the sheave and the davit, and if that is the case, it strikes me we shall have the boat broadside on and capsized. I have paid some little attention to a good many of the boat-lowering apparatus, and there is no doubt, as has been stated, that the soft Manilla rope used in Clifford's will occasionally swell and jamb. All of us who are sailors must at least recollect certain occasions on which this has taken place; I can recall one or two in my own experience, and other Officers will no doubt be able to recall cases of the kind. Another objection is, that the pennants are only of a certain length, which is supposed to be sufficient to allow the boat to reach the water. No doubt if a vessel gets stranded high and dry, and you want to lower a boat by Clifford's plan, you will find perhaps the boat will be a considerable distance above the water, and Clifford's apparatus will be more or less a failure. But I do think the objection made to lowering by Clifford's plan because it has to be done by one man in the boat, has been made rather too much of. I think the instances of lowering by Clifford's have been most successful as a general rule, where the pennants have been properly looked after, and have not been allowed to swell, and where consequently they have not jambed, and this can easily be ensured against, I fancy, by keeping the boats always hung by the tackles with merely a slip which can be knocked off the instant you have got into the boat. Under those circumstances, no strain being on the pennants, if they are looked to frequently, they will not swell or jamb. The boat can then be lowered with perfect safety, and I venture to say, though there are objections to it, yet on the whole with due deference to the opinion of the Committee on boat-lowering, that Clifford's arrangement has proved itself to be the most perfect of all those that have hitherto been tried. At the same time, I am very glad that Mr. Stirling Lacon has brought this before the "public," as he is pleased to call us, and I hope it will continue to be ventilated, and that we shall have something which is a great deal more perfect than anything which has hitherto been placed before us.

Mr. Henwood: I should like to ask Mr. Lacon if he can explain in what way Hill's lowering apparatus failed? From what I remember of the plan when Mr. Hill read his paper here, I can see no possible way by which the boat could be disengaged,

unless it was disengaged by the man in the boat. As regards the fall jambing, if one fall jambs, the other jambs also by the arrangement of the falls, by a system of rollers inside the bulwarks of the ship, so that one end of the boat will not be lowered without the other is lowered, but if there is a kink in one fall, that will stop both going ; they both run or they both jamb.

Captain COLOMB, R.N. : Sir, whenever I hear of a new invention, and the probability of its success or non-success, the first question I ask myself is, "How much more trouble is it going to give?" because I have observed generally that inventions which are new and successful, generally get rid of some existing trouble—they supersede something. Usually when they do not supersede anything, but add an extra trouble, I find the invention does not go down very well. Objections have been made to Clifford's apparatus, for instance, which are no doubt sound and good as far as they go, but I have always taken that the real objection to it was, this extra trouble. I should imagine that the same objection would lie against Mr. Stirling Lacon's plan ; there is a certain amount of hooking and unhooking of the falls, a certain reeving and unreeving of the pennants, all things which occupy time and give trouble, and we have a great deal too much trouble, and not too much time usually on board ships, especially on board merchant ships. I have always thought with respect to boat-lowering apparatus, that a really good one must possess three qualities : 1st, the boat must be lowered square by one man ; 2nd, the same apparatus which is used to lower must also be used to hoist up ; and 3rd, the water, and nothing but the water, should disengage the boat. So soon as we get those three qualities combined in a boat-lowering apparatus, we shall have what we want. I can only say that I have not seen as yet more than two of these three qualities in any boat-lowering apparatus. We have here in Mr. Stirling Lacon's plan the one man lowering the boat ; so far I should say that is good. But the water does not detach the boat ; on the contrary, the boat may be lowered half way down, may be met by a sea, and dashed against the ship's side with slack tackles, it being impossible to disengage her. She may then come down with a jerk, as we know will happen, and men may be thrown out by that jerk. In Clifford's, in the same way you had precisely the same defect, but of course Mr. Stirling Lacon's, so far as it goes, is better than Clifford's, inasmuch as the work of the one man is done inside the ship, instead of in the boat, which all admit to be an advantage. Both Clifford's and Mr. Stirling Lacon's enjoy the advantage of the boat coming down square, which is a very important matter. Now Kynaston's plan does not enjoy that advantage of coming down square. It does not detach on reaching the water, but it is very nearly the same thing, because it can be detached at any moment, which is not the case with either of the other two. But Kynaston's, as Captain Fremantle has very properly remarked, possesses that very great disadvantage, that there is the chance of jambing the falls, and one fall being lowered and the other held on. Those are three plans before us. If I am right in supposing that the three qualities I have mentioned are those necessary for a perfect boat-lowering apparatus, it is quite clear that neither of those three plans are perfect, and I presume that until we get a perfect plan, no committee that ever sat would recommend the doing away of that which, however inefficient it may be, has been in use for such a number of years.

Mr. GUMPEL : No one can question the noble object Mr. Stirling Lacon has in view in bringing forward this plan, but still I must confess that it has its deficiencies, though perhaps in minor points. One point which has been overlooked is this, that as soon as the boat reaches the water, it sheers off, and brings these chains into a position in which they do not fairly run over the sheaves ; a kink, or anything of that kind might occur, and a stoppage take place in the sheave, or davit. These things are likely to happen with this apparatus, and that is only one of many other objections which can be raised against it. The last speaker mentioned three requisites for any boat-lowering apparatus, the first being to have one man to lower from inboard. Now this can be done with common falls, by means of a simple apparatus, one man can at the same time see the boat, and, by means of a lever, allow the boat to go down on an even keel at any speed, and at any moment he may choose. I can show that at any time, and if permitted will bring the whole thing before this Institution. The second requisite was that the boat should be disengaged as soon as she reaches the water. This, too, can be done ; a certain form of hook can be attached to the

existing block, and be made so as to disengage itself as soon as the boat is completely waterborne, not like Hill's, which is not always disengaged when the boat reaches the water, since there are cases in which the strain is constantly kept on the hook, even after the boat is afloat, and the hook cannot disengage. The only way it does disengage is when the wave strikes the boat, and suddenly disengages the slings from the hooks. I say that is the only way in which it can be done, and it is admitted by people who have tried it, that when a boat is lowered in smooth water, with good way on the ship, as soon as the boat reaches the water, the strain is kept on the hook, and the hook does not disengage. All this can be avoided by a very simple contrivance. The boat, as she becomes waterborne, disengages herself, and the hook can be so constructed that when the boat hangs on the falls, it requires the pull of the weight of the boat to disengage it, or you may make it so that the pull of half the weight of the boat will disengage it. She does not disengage until she is completely waterborne. I am prepared to show this. Now comes a third point, that of using the same tackle for raising the boat. This also can be done, it is simply a question of cost. To the arrangement which I have devised for lowering the boat, a small windlass could be attached, enabling, according to the weight of the boat, one or several men to hoist her.

Mr. Hill: I am not getting up here to criticise or find fault in any way with any apparatus, but, quite unexpectedly to myself, I heard my name mentioned by Mr. Lacon, in his paper, in reference to my invention which has been tried on board the "Challenger." I have not met with one sailor who could advance any great objection against the invention, and I rise here now to ask if any gentleman who is here can point out any faults therein. I may say I hope soon to have a model which every one may inspect in this Institution. Now in order to show you that the loss of the "Challenger's" boat from the davits must not be considered adverse to the invention, I will read you a copy of the report which Captain Nares sent to the Admiralty. "The port quarter boat fitted with Messrs. Hill and Clark's Patent Disengaging Hooks, had been kept ready for immediate lowering, with the safety pins out. As the men were about to enter the boat to replace and secure them, a very heavy sea, combined with a lurch, dipped her in the water. The hooks immediately slipped (as is Mr. Hill's intention), and the boat was washed from the davits. Before steps could be taken to recover her, the foremost thwart to which the boat rope was attached, was carried away, probably in consequence of the boat being struck against the ship's counter, and she drifted astern, and was lost.

"Although this boat was undoubtedly lost in consequence of the falls being fitted with Hill and Co.'s disengaging hooks, I still think them most valuable, and on seeing the boat ready for lowering with the safety pins in, which prevents the falls unhooking, I made the men try to draw them out, and finding that they could not do so without first using a marline-spike to twist them round, I ordered them to be kept out. The pins were probably in the present case a little large and stiff, through being galvanized."

The galvanizing was done at the last moment, and that accounted for a little stiffness. Captain Nares ordered me to fit another boat with the apparatus, and the "Challenger," I am happy to say, has arrived at Gibraltar with that apparatus on board, and no account of any further accident has been recorded.

In conclusion I may add the "Challenger" is not fitted with our lowering gear, but simply with our patent disengaging hooks. The lowering gear enables one man to lower the boat upon an even keel by the old falls, without fear of accident.

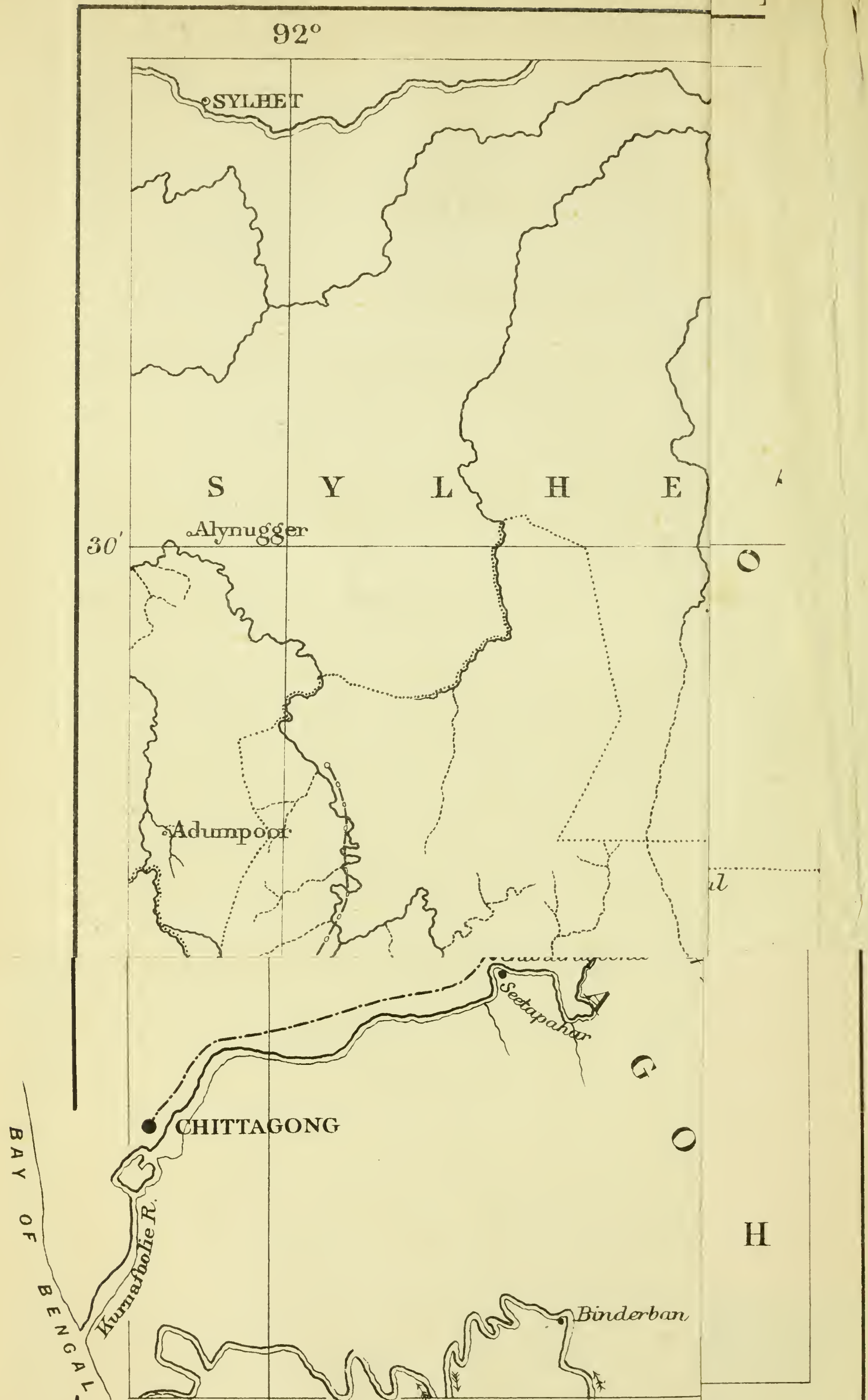
The Chairman: I believe it is not the duty of the Chairman to criticise, but rather to try and make matters as pleasant as possible for all parties. I wish, however, to make one remark with regard to the old Service plan, because I think it will be useful. If boats are lowered into the sea in the manner just displayed to us, there would be great difficulty in unhooking the tackles, even if the boat came down fairly; but the "Phaëton" having been alluded to, I must tell you that in that ship we always had a strong boat's painter passed forward along the ship, and stopped up to the main chains, just sufficiently long, so that when the boat touched the water the painter caught the boat and kept her from going aft, so that the men in the boat could unhook the tackles. With this precaution I have never had any hesitation in smooth water in lowering quarter boats when the ship had headway. I believe that

another matter has been very much neglected. We have been fitting our quarter boats, which is quite necessary, but we have neglected our stern boat. I believe a boat can be let go from the stern and let run on Mr. Lacon's or any other similar plan. It is generally a smaller boat, and therefore I have found that by having the stern boat fitted so that she could be let run with a pennant in the manner just described, it can be done with more safety than from the quarter, because there is no doubt that where a boat is slipped from the tackles, either on this or any other plan, strict attention must be paid to the roll of the ship, which is not an easy matter, and if any mistake is made in carrying out these complicated arrangements, the consequences may be very serious. One or two remarks have been made which I may just notice. One was with regard to letting these chains drop on the men. I do not think much of that, nor do I think that the chain could get into the screw well. I do not think that the chain would injure the men, but if it did, you might splice a rope on to the end of the chain. I dare say it would not be pleasant to have it on one's head, but I do not think it would injure a man, and Jack does sometimes stand a good crack without caring much about it. Then it was said that the lead-line would interfere, because if the lead-line happened to jamb, the boat would be swamped by it. I do not think the lead-line would hold on. I think it would break immediately such a strain came upon it. I do not know that an Officer is ever placed in a position of greater responsibility than he is when he is called upon in bad weather to decide whether to lower a boat after a man who has fallen overboard, because the question is this, whether you are not going to lose perhaps eight or ten men in the endeavour to save one. I have heard what my friend Mr. Stirling Lacon has said, and I should really prefer his plan to either Kynaston's or Clifford's. I have never adopted either of those plans, because I considered that they were just as likely in the long run to cause accidents as they were to prevent them; that was my opinion. For that reason I always fitted my boats in the ordinary way. I consider Mr. Lacon's a very sensible plan for smooth water, but I see the objection of letting go when the ship is not on an even keel. If the vessel happened to be rolling heavily, the boat might be let go at some distance from the water, which would be objectionable. This question of submitting plans by models is, I think, most unsatisfactory, and few have the opportunity of having them put to actual test. The question of saving life at sea is one to which many may remember my name has been attached for a very great number of years. I have always had it on my thoughts. I think a good deal could be done to save life at sea, and I think very little has been done. I hear that in the United States they have an association for the purpose of promoting the safety of life at sea, and that that association has done a great deal of good. I am happy to say an association of a similar kind has been formed in England, and will be heard of in a very short time. I trust everybody who can, who has this great and important question at heart, when they see this opportunity afforded them will come forward to assist that association to promote safety of life at sea, by putting a model merchant ship into the water to contain all the best means and appliances by which life can be saved, whether it be for the lowering of boats, or for saving the breaking of chain cables, or preventing collision, which is the most important thing of all. We have railways on shore; we have the Board of Trade enforcing railway breaks, not only that, but enforcing the adoption of the very best break that can be procured. At sea we have ships running with a screw propeller which has no power whatever to arrest the progress of the ship, and until we do get a break of some kind to our ships we shall never stop collisions, because if the helm happens to be put the wrong way, on the ship must go, and she must go over everything in her way.

Mr. Stirling Lacon: I ought to have spoken before Admiral Elliot, in answer to Captain Wells, who spoke of the danger from the chain falling on the men. Now there is no necessity to have a chain. You may have rope pennants. Then, as to the fouling of the screw, I should think the first thing the Commanding Officer would do in the event of lowering the boat would be to stop the screw. With regard to Mr. Hill's remarks, he will recollect that I stated Admiral Richards had written to me saying that it was through no fault of Mr. Hill's plan that the accident took place.

The Chairman: I am sure we are greatly obliged to Mr. Lacon for having brought this subject forward in the very able manner he has done.


SKETCH MAP
to illustrate the operations of the
CHITTAGONG COLUMN
LOOSHAI EXPEDITIONARY
FORCE
1871-72.
And shewing routes followed by other Expeditions.
NOTE.
General Brownlow's 1871-72
" Bourchier's 1871-72
" Nuthall's 1869
Mr. Edgar's in 1869-70
Bakers in 1869
Colonel Lister's in 1849-50
Permanent Post
Scale of Miles.
0 5 10 20 30 40 Miles
92°
30'
93°
24°
23°
SYLHET
Barak R.
CACHAR
Lukhipoor
Hailakandy
Chargola
Alynugger
Alexandrapoor
Jubucharra
Adumpoor
Monir Khal
Mynadhur
Tipai Mookh
Chengchal
New Kholel
Chipuee
Gen. Nuthall's Camp 1872
Dullessuree R.
Sooklental
Bypuri Bazaar
To Oodeipoor 30 miles
Chauppho
Line of Posts held by Tipperah Rajah's Troops
Khagorea Police Post
DEMAGREE
RUTTON POOEA
KASSALONG
BURKUL
Saichal
RANGAMATEA
Chandraghona
CHITTAGONG
Binderban
Phuwar
Pindoo
Belasurree
Line of Police Posts
YANDONG
KOLATONG
KEOKCHOOK TONG
The Tooi Pooi said to flow here
S Y L H E T
C A C H A R
M U N E E P O O R
H I L L
T I P P E R A H
L O O S H A I
S O O K P I L A L
V O N P I L A L
P O I B O I
L A L B O O R A
T A N G D O N G
N O R T H E R N H O W L O N G S
S O U T H E R N H O W L O N G S
S H E N D O O S
C H I T T A G O N G
A K Y A B
B U R M A H
BAY OF BENGAL
J. Jobbins


92°
SYLHET
S Y L H E
Alynugger
30'
Adumpoor
Seetapahar
CHITTAGONG
Kurnafoolie R.
BAY OF BENGAL
Binderban
92°

J. Jobbins

LECTURE.

Friday, February 14th, 1873.

Major-General J. W. ARMSTRONG, C.B., Deputy Adjutant General, in the Chair.

AN ACCOUNT OF THE PROCEEDINGS OF THE CHITTAGONG COLUMN OF THE LUSHAIE EXPEDITIONARY FORCE, 1871-1872.

By Brevet-Major C. J. East, 41st Regiment, Asst. Quartermaster-General, Bengal.

On the south-eastern frontier of Bengal, lie the British districts of Cachar, Sylhet, and Chittagong, the two former separated from the latter by the nominally independent state of Hill Tipperah. The state of Munnepore, which enjoys about the same amount of independence as Hill Tipperah, joins Cachar on the east, and to the south of this district and to the east of Hill Tipperah and Chittagong, extends the country occupied by the Kookie tribes, or, as they are commonly called, the Lushaies. These tribes, and others of a similar character, occupy the mountainous country extending from our south-eastern frontier to Burmah.

Previous to last winter our knowledge of the Kookies and of the country they inhabit was most limited, and we probably learnt more about them from their unwelcome visits to us than from the almost resultless expeditions which had been attempted against them. For years past, these tribes had been in the habit of raiding into our territory, when much property was destroyed and numerous British subjects carried away into captivity.

It is necessary to give a short account of the raids made from time to time, and of the measures, both conciliatory and punitive, with which the Lushaies were treated, to show that the expedition lately undertaken was an absolute necessity, and that although the punishment we then inflicted was in some instances severe, it was not more than was necessary and deserved.

In talking of these tribes it will perhaps be more convenient to call them the Lushaies, by which name they seem to be now generally known, although in fact this term is only properly applicable to the

Note.—For Narrative of the Cachar Column of the Lushaie Expeditionary Force, see " Journal of the United Service Institution of India," Vol. II, page 35, *et seq.* See also " Woodthorpe's " Lushai Expedition."—Ed.

royal or ruling family, from which the chiefs of the several tribes are descended, and as the chiefs can marry only Lushaies, the purity of the family is still maintained.

The Lushaies are divided into several independent tribes or communities, which occasionally undertake joint expeditions against our borders or against some other tribe, and now and then fight one with another, as the circumstances of the time may dictate. The principal of these tribes are those of Poiboy, Impanu, Vonpilal, and the sons of Vanolel, Lalbourah, and Tangdong, in the north-east of the Lushaie country; of Sookpilal, which occupies the country east of Hill Tipperah; of Rutton Pooea, whose territory adjoins the hill tracts of Chittagong; of the Sylhoos, one of the most warlike of all the tribes, occupying the country to the south of Sookpilal, between Rutton Pooea and the Howlongs; and, finally, the northern Howlongs and the southern Howlongs, which occupy the country to the east of the Syloos and extend considerably to the south, being separated from Burmah by the Shendoos, another raiding tribe, which, however, is supposed to be separate and distinct from the Lushaie Kookie tribes.

It is generally supposed that the Lushaie Kookies have been gradually driven towards our frontier by tribes further east and south. The earliest account that can be traced of the Kookies takes us back to the year 1826, when they attacked and barbarously murdered a party of woodcutters from Sylhet. In 1844 they made a night attack on a village in the same district, and carried off seventy heads and six captives. A small detachment of troops then sent into the hills reduced to submission the offenders and brought in their chief Lal Chokla, who was transported for life. We next hear of them in 1849, when they burnt three British villages in Cachar, killed many of the inhabitants, and carried off a number into slavery. The consequence was, that the people occupying the country where this attack had been made, deserted it, and our border in that direction became much unsettled.

The Government of India consequently ordered an expedition against the Lushaies, in the hope that prompt punishment might prevent further raids, and Colonel Lister, the Political Agent in the Cossyah Hills, was appointed to the command. He started in January, 1850, with 6 native Officers, 29 non-commissioned Officers, and 200 sepoys, and penetrated about 80 miles in a southerly direction from Cachar, when he surprised and destroyed the village of a chief named Moollah. Finding, however, that the Lushaies were more numerous and powerful than had been supposed, he retired again into British territory. It is as well to notice here some of the information contained in Colonel Lister's report of his expedition, as this had to be taken into consideration when the strength of the columns for the late campaign was determined.

He reported that the road he traversed was through thick woods, varying only in intensity and in character from bamboos to large forest trees, and utterly uninhabited. The track was always well marked. Moollah's cantonment was on a mountain 2,500 to 3,000 feet high, and other large villages were on higher peaks, so situated probably for the sake of the salubrity as well as the safety of the positions from attack. He

described the Lushaies as a powerful tribe under six chiefs, one of whom is supreme. They all have their separate cantonments, with a number of dependent villages attached. In these cantonments the fighting men reside; in the dependent villages are located the ryots, who are merely used for tilling the soil. The fighting men, he said, consisted, firstly, of Lushaies, who appear to be a cross between the Kookies and Burmese; secondly, of a certain number of true Burmese, entertained as soldiers; and thirdly, of refugees and outlaws from Munnepore and our own frontier. The chief at the head of the tribes was said to have 300 Burmese in his service. His head-quarters, which lay south-west of Moollah's village, could be plainly seen with a telescope, and appeared to be a cantonment laid out with great regularity, and containing not less than 3,000 houses. The whole of the chiefs are said to be able to raise from 5,000 to 7,000 fighting men, part being armed with muskets and the remainder with spears. Finally, he considered that in any expedition undertaken against them a good deal of stockade-fighting might be expected, and that although their muskets and other offensive weapons were not to be dreaded, they might cause great difficulties by their expertness with the dhao, and the facilities their woods afforded both in materials and position for throwing obstacles in the way of an advance and of a retreat. He considered that a force of 3,000 troops would be necessary to subdue the Lushaies.

The sources from which Colonel Lister obtained this information were certainly not trustworthy, for nowhere in the country did the expedition of last winter find large military cantonments nor Burmese soldiers, and the fighting force of the Lushaies was below what had been represented.

The immediate results of his operations appear to have been satisfactory, for at the end of the same year the Chief Sookpilal came into Cachar on a friendly visit to the Deputy Commissioner, and a small trade afterwards began between the Lushaies and our own frontier people.

Up to 1862 our border was undisturbed, but in that year three villages near Adumpore, in Sylhet, were attacked and burnt, and the inhabitants either killed or carried off as captives. In consequence of this, negotiations were opened with Sookpilal, and he was promised a small annual money payment if he would prevent his own people and his neighbours from raiding; he was besides to pay an annual tribute to Government. Tea gardens now began to be established along the borders of Cachar and towards the Lushaie country, and this appears to have made the Kookie tribes rather uneasy. Matters remained quiet however, until the close of 1868, when some villages in Sylhet were attacked, and in January of the following year, the tea gardens of Loharbund and Moneirkhal, in Cachar, were assailed.

An expedition, under General Nuthall, was then sent into the Lushaie country, but it started at too late a season to be able to effect anything. It advanced in three columns, two of which penetrated some distance into the country, but they had to retrace their steps before the inhabited parts were reached. Their march was entirely unopposed.

From December, 1869, to March, 1870, the Deputy Commissioner of

Cachar, with a small police escort, traversed a great part of the northern and western Lushaie country, made friends with the representatives of many chiefs, had a satisfactory interview with Sookpilal, and was not in any way interfered with or molested by the inhabitants.

Before noticing the raids made on Sylhet and Cachar during the winter of 1870-71, which were on a more extensive scale than any previously undertaken by the Lushaies, and were the immediate cause of the expedition of last winter, it will be as well to give in a few words the history of our dealings up to this time with the Lushaies on the Chittagong side.

In January, 1860, an inroad was made into Hill Tipperah by some 400 or 500 Kookies, when several villages were burnt and many inhabitants slaughtered. Following the course of the Fenny River, this band of raiders entered British Tipperah at Chagulneyah, burnt 15 villages, slaughtered 185 of the inhabitants, and carried off 100 captives. After staying a day or two in the plains they hurried off to their hills, so that although troops and police were sent after them, they retired without being in any way punished. These raiders were believed to belong to Rutton Pooea's clan. In January, 1861, a strong force of police under Captain Raban, proceeded against Rutton Pooea's village. On their approach, the Kookies set fire to the village and fled into their woods. After doing what damage was possible in the immediate neighbourhood, the police retired to British territory without having been able to inflict any severe punishment on Rutton Pooea's people. Captain Raban had found the country extremely difficult, and had to send back the elephants with which he started, it being impossible to take them on. The result of his expedition however was, that in the following September Rutton Pooea came in to the British frontier Officer and made his submission. Through him communications were opened with the Syloos and Howlongs, of whom we then knew nothing.

Our relations with these two tribes, although by no means intimate, have since that time remained on a more or less satisfactory footing, and although they have raided on other parts of our frontier, they have made no attempts whatever against the district of Chittagong. It is said they became so friendly in their interviews with our civil Officer at Kassalong, that one of their chiefs actually proposed that he should join them in making a raid against Cachar!

In the winter of 1870-71, Major Graham the Civil Officer, and Major Macdonald of the Survey, proceeded with a small police escort on a friendly mission to the Syloo country. They had interviews with a few chiefs and with some head men of villages, but they were positively forbidden by the Syloos to proceed beyond the first village reached, and they had therefore to retire again, having been able to penetrate some six or seven miles only into the country.

To return to the Cachar side. In January and February, 1871, whilst Mr. Edgar the Deputy-Commissioner of Cachar was travelling in Sookpilal's country, the most serious raids which had yet taken place, occurred. Several tea gardens and villages in Sylhet and Cachar were attacked, when much property was destroyed and considerable plunder

carried off. Many coolies were killed, Mr. Winchester a tea-grower was murdered at Alexanderpore, and his little girl taken away, with many other captives. Extensive raids were also made on villages in Hill Tipperah and Munnepore. The attacks made on this occasion were bolder than any which had preceded; the Lushaies did not hurriedly retreat as had been their habit, but they stayed for three or four days in the neighbourhood of the tea gardens, and if their first attack failed they would renew it on the following day. Their force was not accurately known, but it is supposed they had not less than 800 fighting men. It was too late in the season to attempt to punish the raiders, and it was impossible to do more than to push forward troops and police to the frontier posts so as to guard more securely against further attacks. Great anxiety was felt for Mr. Edgar's safety, and two or three small detachments of troops were sent out to meet him. Sookpilal fortunately remained friendly, supplied Mr. Edgar with food, and the latter with the assistance of one of the detachments which had arrived close to him, was enabled to return in safety to British territory without encountering any of the raiders.

Very careful inquiries were instituted as to the tribes to which the raiders belonged, and it was ascertained with tolerable certainty that the Howlongs, Syloos, and the North Eastern Lushaies, under Lalbourah, had joined together to attack us, and that they had afterwards divided between them, the plunder and the captives.

Various reasons have been ascribed to the Lushaies as inducing them to make these raids on our border. Some people say, they are undertaken when a chief dies, in order to secure a certain number of heads to bury with his body, for according to the Lushaie belief, the number of slaves the chief will have in the next world, depends on the number of heads that are interred with him; according to others the gradual extension of tea gardens is distasteful to the Lushaies, and they have determined to do all in their power to drive out the planters. But it hardly appears necessary to seek for other causes than those which generally actuate wild border tribes, which for the sake of plunder and from the love of war-like excitement, make incursions into their neighbours' territory. The Lushaies were found to be a happy, easy-going people, not over-fond of hard labour and consequently putting a high value on slaves, whom they employed as hewers of wood and carriers of water; slaves also were used as articles of barter, and were exchanged with the adjacent tribe of Pois for guns, as many as five women being often given for one musket.

However, be the reasons what they may, which induced the Lushaies to raid, it had become very evident that these constantly-recurring incursions of theirs into British territory must be stopped, and it having been found impossible to do so by means of peaceful overtures or conciliatory measures, the Government of India had of necessity to order an expedition into their country, and in order that its results might be permanent, it was advisable that it should be on a more extensive scale than those which had already taken place.

The object of the expedition was not to be entirely punitive. The force was to occupy and explore as much of the Lushaie country as

possible, and if its advance was opposed, the neighbouring villages were to be attacked and burnt: in cases where it could be ascertained that particular chiefs or villages had been concerned in raids, the offenders were to be fined, and every effort was to be made to release the captives. It was to be explained to the natives that they were completely in our power; endeavours were to be made to establish permanently friendly relations, to induce them to receive occasionally our agents in their villages, and to allow British subjects free access to their country. Further, opportunity was to be taken of showing them the advantages of establishing a regular trade with the people on our frontier.

Government decided that the expedition should consist of two columns, one to start from Cachar, and the other from Chittagong; that operations should commence by the 15th November or 1st December at latest, and be brought to a close by the 10th March. Between these dates the climate was believed to be tolerably healthy; at other times, not only must great sickness have been experienced, but the country would have been impracticable, owing to the long-continuing and heavy rains and the consequent flooding of the rivers. The forces of the Rajahs of Munnepore and Tipperah were to co-operate with the British troops, the former acting with the Cachar column and the latter with the force from Chittagong, whilst to the north, the friendly services of Sookpilal were to be brought into requisition as much as possible, and on the south, the Chief Rutton Pooea was to be engaged to give us all the assistance in his power.

The strength of the columns and the particular regiments to be selected naturally rested with the Commander-in-Chief, Lord Napier of Magdala. To determine the strength and composition of the force, it was necessary to consider the objects to be achieved; the nature of the country; the distance to which it was to be penetrated; the time the expedition was to last; and the amount of opposition which might be expected. The objects of the expedition and the time of its duration have already been stated, and it was evident that they would necessitate a long line of advance into a hostile country on which depôts and posts would have to be established and occupied by small detachments of troops. It might therefore be calculated, that about one-third of the force would be available for active operations at the most advanced point, after allowing for garrisons of posts, and for sick.

As already stated, our knowledge of the country between the Chittagong hill tracts and Cachar was extremely imperfect. The river Kurnafoolie was known to be navigable up to the Lushaie hill-ranges occupied by Rutton Pooea. These ranges, about 2,000 feet high, run from north to south, and beyond them to the east many parallel ranges had been seen, rising to 4,000 and 5,000 feet above sea-level, and increasing in height towards the north, where it was supposed they joined the water-shed, which separates the rivers running to the sea from those flowing towards Cachar. Some 30 or 40 miles north of this watershed, is the country of Sookpilal, and between his northern boundary and Cachar, is an extensive tract some 30 miles

across, of low swampy valleys running north and south, separated by small ranges, and the whole uninhabited.

The Lushaie valleys were known to be uninhabited, uncultivated, and covered thickly with forest, their villages and cultivated ground being on the high ranges, access to which was by narrow and difficult paths. It was advisable therefore, that troops accustomed to mountain work and who could do good service in opening out roads through a forest-clad country, should be employed. As probably a most limited amount of baggage only could be taken, and as it was believed that no food-resources of any value would be found available, occasional privation and hardship were to be expected, and therefore it would be necessary to employ soldiers with good stamina, like the Punjabees and Goorkhas, who it was known could better stand hard work for a limited time in a hot and very moist climate, than Bengalees or men of the north-west.

As regards the opposition to be expected, we have already seen what Colonel Lister wrote, and how he was of opinion that many stockades would have to be attacked; and Mr. Edgar, the Deputy Commissioner of Cachar, whose recent experience was probably more extensive than that of any other frontier Officer, considered that in any expedition sent against the Lushaies a strong force would be necessary, and that it should be thoroughly organized and equipped.

It would appear that the recommendation in Colonel Lister's report was accepted for the total infantry force, for the two columns consisted of 3,000 men, to which was added for each column one company of sappers and half a battery of mountain artillery. The exact detail of the troops, with each column, is as given below:—

Cachar Column.

Brigadier-General Bourchier, C.B., 1 Assist.-Quartermaster-General, 1 Brigade Major, 1 Aide-de-Camp.

Half Peshawur mountain battery with 2 150-lb. steel guns, and 2 $5\frac{1}{2}''$ mortars, 37 gunners, and 35 infantry soldiers attached, trained to work guns.

One company of sappers, with equipment, 100 men.

22nd Punjab Native Infantry	500 picked men
42nd Punjab Native Infantry	500 ,,
44th Punjab Native Infantry	500 ,,

Chittagong Column.

Brigadier-General Brownlow, C.B. and A.D.C., 1 Assist.-Quartermaster-General, 1 Brigade Major, 1 Aide-de-Camp.

Half Peshawur mountain battery, similarly equipped.

One company of sappers, with equipment, 100 men.

2nd Goorkhas	500 picked men
4th Goorkhas	500 ,,
27th Punjab Infantry	500 ,,

The guns, mortars, and artillery equipment to be carried on elephants.

To each General a Political Officer was attached. These two Officers, Mr. Edgar and Captain Lewin, both of whom had great experience on the frontier, were to advise the Generals on all questions which might arise with the native Chiefs; supreme political authority, however, was invested in the Generals, who were to be held responsible for both political and military proceedings.

The Rajah of Munnepore kept some 2,000 men in the field, but owing to the difficulties of communication between his troops and General Bourchier, their effective co-operation with the Cachar column was hardly to be expected. From the advanced position they took up, they rendered very important service in enabling numerous Munnepore and British captives to escape to them from the Lushaie country, and they must also have afforded considerable security to the left flank of General Bourchier's line of advance. General Nuthall accompanied the Munnepore contingent in a political capacity. The troops of the Tipperah Rajah were, on General Brownlow's recommendation, detailed to hold certain posts on the Tipperah frontier. To each column there was attached a force of military police, to be employed on such duties as the Generals might consider most advisable.

The equipment, commissariat arrangements, and carriage for the whole of the troops were much the same. The operations of the two columns were however entirely distinct, and although it was intended originally that they should effect a junction, this was not done, owing to reasons which will be noticed hereafter.

This account will now be confined exclusively to the proceedings of the Chittagong column, with the exception of showing generally the line of advance followed by General Bourchier.

The following scales of equipment, regimental carriage, and establishments were ordered:—

Equipment.

Each soldier to carry	lbs.	ozs.
Great coat	7	0
Waterproof sheet, 7′ × 4′, to be worn in a roll over the shoulder with great coat	4	0
Arms and accoutrements	16	0
60 rounds ammunition in pouch	5	7
Two days' rations, say	5	0
Sundries	4	9
Total	42	0

To the troops not already possessing them, kookries were issued and boots, and bandages to bind round the lower part of the leg as a protection against leech-bites were also supplied.

Carriage.

Carriage to be provided by Government to the following extent:—

	lbs.
General Officer Commanding	80
Each Staff Officer and Commanding Officer of regiment, extra for Office	40
British Officers	40
Native Officers................................	20
Troops	12
Followers	nil
Cooking utensils, per regiment	160
Ditto per separate company, when detached	40
Hospital stores................................	80

Establishments.

Private servants and chargers:—

British Officer, each......	1 servant.
,, ,, ...	1 pony and 1 syce.
,, ,, ...	1 grass-cutter for every 2 ponies.
Native Officers..........	1 servant between 2 Officers.

Regimental followers—Three per separate company, or 24 per regiment, and to provide for bheesties, cooks, sweepers, cobblers, &c.

One dandy for carrying sick or wounded for each company.

The kookrie was a most indispensable article of equipment. Men soon learn to use it fairly, but a Goorkha, whose national weapon it is, wields it with wonderful skill. Bamboos as thick as a man's arm can be cut through with one stroke, and these, by means of the kookrie, can be fashioned into water vessels, drinking cups, matting, bedsteads, chairs, and, in fact, almost anything. The bandages as a protection against leech-bites did not prove of great service, as the men generally preferred marching with bare legs. The scale of carriage laid down for Officers and men proved generally sufficient, with the exception that for the former there was very great difficulty in carrying cooking utensils sufficient, within the prescribed limit of 40 lbs. Of the ponies allowed to Officers I may here mention that three only, with much trouble, reached the front, and that it was impossible to ride them until we commenced our return march, when roads had been made.

Ammunition and Entrenching Tools.

Each half battery was supplied with 118 rounds per gun and 104 per mortar, and 100 rounds per gun and mortar were placed in reserve at Chittagong. Fifty Hales' rockets, with two troughs for firing them, and 50 blue lights were ordered for each half battery; the rockets, however, had to be obtained from England, and did not arrive until rather late.

The service ammunition of the infantry consisted of 200 rounds per man, distributed as follows:—

60 rounds in pouch.

40 rounds, 1st regimental reserve, in leather cartouches placed in

bullock boxes, two cartouches in each box. The filled cartouche weighs 37 lbs.

100 rounds, 2nd regimental reserve, in bullock boxes without cartouches. Each bullock box contained 800 rounds, and weighed when full 93 lbs., and was provided with a rope and bamboo for carriage by two men.

In addition to the above, 100 rounds of small-arm ammunition per man, packed in camel boxes, was placed in reserve at Chittagong. The whole of the infantry was armed with Enfield rifles; the Sapper company had smooth bores.

The Sappers took with them their own company equipment of engineering tools and stores, and in addition to these the Ordnance Department furnished—

500 mamooties, a sort of native shovel.
100 pickaxes.
200 felling axes.
200 hatchets.
25 crowbars.

A few native blacksmiths, with forge for the repair of tools, were also sent.

Rations.

The daily ration of food for troops, followers, and coolies was—

	lbs.	ozs.
Atta, flour, or rice	2	0
Dal—a pulse	0	4
Ghee—clarified butter	0	2
Salt	0	$0\frac{2}{3}$

Rum was issued when possible, and to non-rum-drinkers an occasional allowance of tea and sugar was given.

The Officers' ration, supplied by the Commissariat Department, was—

	lbs.	ozs.
Biscuit	1	0
Meat—Australian or salt	1	0
Rice	0	4
Sugar	0	$2\frac{1}{2}$
Tea	0	$0\frac{5}{7}$
Butter	0	1
Salt	0	1
Flour	0	6
Rum, low proof	0	2 drams.

A very occasional issue of potatoes or of preserved carrots was also made.

Owing to the excessive moisture of the climate, the flour and atta had to be packed in waterproof bags to prevent its becoming mouldy, and the whole of the packages of the Commissariat were arranged so as not to weigh more than 40 lbs., the weight which it had been decided

coolies were to carry. A 9-gallon cask of rum formed a load for two coolies, and owing to there being at first a deficiency of these small casks, it was impossible to get rum up to the front for some considerable time.

The carriage to be employed consisted of coolies or porters and elephants. It was considered unadvisable to use mules for many reasons, the principal being the difficulties of the paths, the probable scarcity of water, the deficiency of encamping ground, and the long distance, viz., from the Punjab, they would have to be brought. The original orders directed 2,000 coolies to be entertained, of which 600 were to carry Officers' and men's kits and ammunition, and the remaining 1,200, commissariat supplies; it will be seen that this number had to be increased. With the exception of 300 Nepaulese engaged by the Civil Authorities, all the coolies were collected by the Commissariat Department in the Punjab and North-Western Provinces and forwarded to Calcutta by rail. There, under the orders of the Commandant of the cooly corps and the two British Officers appointed to assist him, they were formed into divisions of 100 men, each division having one sirdar or head man, and four mates who were placed in charge of sections of 25. To maintain something like discipline amongst them, some half-dozen non-commissioned Officers of native regiments at Calcutta were attached to the corps. Each cooly was provided with a blanket, a pair of shoes, leg-bandages, and a dhao, which is a sort of large hatchet-knife, and can be used either as a defensive weapon or for cutting down trees and brushwood; a waterproof sheet was also supplied to every four coolies.

One hundred elephants eventually increased to one hundred and seventeen were forwarded to Chittagong, but these could not be employed until roads had been opened out.

A survey party consisting of four Officers and a native establishment of thirty-two men, was attached to the column.

The construction of a telegraph line was ordered from Chittagong to Demagree, where the most advanced depôt was to be placed, a distance of about 125 miles, and 50 miles of wire were to be taken to form a flying line if necessary, on the advance of the column into the enemy's country.

On arrival of the troops in Calcutta they were placed on board river steamers and flats, and despatched *viâ* the Sunderbunds to Chittagong. The six hours at sea this voyage necessitated, could fortunately at that season of the year be undertaken without fear of rough weather. It took eight days by this route to reach Chittagong, and unfortunately the result of travelling through the unhealthy Sunderbunds was that in every detachment of troops one or two cases of cholera occurred, either on the passage or immediately after arrival; happily however the disease did not spread. The first troops to reach Chittagong were the 2nd Goorkhas and Sapper Company, which arrived on the 5th November, the 27th N.I. and half battery landed on the 21st November, and the 4th Goorkhas on the 25th November. The coolies were despatched in batches of about 400 from Calcutta by sea, the voyage taking three days. The first detachment reached Chittagong on the

7th October, and they continued to arrive until the 7th December, a supplementary detachment of some 200 and odd landing on the 15th January.

On the 28th October, the General and remainder of his staff arrived, the Assistant Quartermaster-General and Principal Commissariat Officer having been sent down early in October to collect as much information as possible and to make all preliminary arrangements. The General had been ordered to commence his advance from the advanced depôt to be established at Demagree on the 1st December. The base of operations was to be established at Chittagong, and steps were at once taken to secure the necessary buildings for a depôt hospital, to which all seriously sick troops and coolies could be despatched from the front: proper shelter had to be obtained for the reserve ammunition and stores and for the camp equipage of the troops, which under orders from the Commander-in-Chief was not to be taken beyond that place.

The General's attention was first given to the security of the country which he would leave behind him on either flank of his line of advance. Hill Tipperah had suffered much from Lushaie raids during the preceding winter, and considerable outlying districts had in consequence been abandoned by the inhabitants. In communication with the political agent at Hill Tipperah, it was determined to establish five police posts, extending from Kailashur to Oodehpore, and to build a stockade for 100 men at Chouppho o, whence constant patrols would be sent to Sabong Mabrong, the part of the frontier most likely to be invaded, and also to Khagorea, the police post on the General's extreme left. The Tipperah Rajah's troops were poorly armed and disciplined, and the most to be expected of them was that they would make a successful defence if attacked.

A force of three British Officers and about 400 men of the military police battalion were placed at the General's disposal. With part of these he determined to re-occupy certain posts which had been held in previous cold seasons along our frontier to the south of the Kurnafoolie River, and to establish others, as it was thought probable that the raiding tribe of the Shendoos, who are our neighbours on this side, might take advantage of our being occupied with the Syloos and Howlongs to make invasions into our territory, and which indeed they attempted to do, but without success. A British Officer and 130 men were to accompany the troops of the expedition, and 50 were to occupy the stockade at Khagoreea. The distribution of the police was as follows, and the posts they occupied are marked on the map:—

Khagoreea	50
Belasurree	50
Phurwar	40
Pindoo	50
Thursa	30
Chima	60
With advance	130
	410

It is necessary to give now a short description of the River Kurnafoolie, as far as Upper Burkul; of the posts which were established on it; and of the means at the General's disposal for moving troops up the river. The town of Chittagong on the right bank is about 15 miles from the sea, and so far steamers of 2,000 tons can proceed. From Chittagong to Chandragoona, a distance of 27 miles, the river continues a fine wide stream, but in places at low tide with a depth of only 6 feet, and flows through a flat, well-cultivated country inhabited principally by Bengalees. Above Chandragoona, the hilly country of the Chukmas a tribe having much resemblance to the Burmese, is traversed, and for 34 miles up to the station of Rangamattea the river is navigable by flat-bottomed river steamers and flats. Just below Rangamattea a bar existed, which when the river fell would prevent steamers reaching the station, and a dredge which had been sent down from Calcutta for the purpose, was put to work upon it. Rangamattea was the head-quarters of the Frontier Police Battalion and the station of the Deputy-Commissioner, and with the exception of a small police post at Kassalong, had been hitherto the most advanced British position in this direction. As it was impossible for river steamers to proceed beyond this place, all troops and coolies had to be landed here, and for their shelter the civil authorities had prepared rough huts of bamboo, with the floors well raised off the ground; these huts would hold easily 500 men. A small commissariat depôt was also established here. The General had two river steamers at his disposal, the "Koel" which would carry 280 men, and the "India" which would take 150; and in order to increase the means of transport several large country boats were roughly decked for the accommodation of troops, and four or six of these, each holding 25 men, were towed up by each steamer. The voyage from Chittagong to Rangamattea and back again generally occupied three days.

From Rangamattea to Kassalong, 17 miles, the depth of water was nowhere less than 2 feet 6 inches, and on this part of the river it was possible to use the large-sized country boats; but from the latter place to Lower Burkul, 12 miles, no boats drawing more than 18 inches could pass. Above Rangamattea the river narrowed much in places, and occasionally flowed through picturesque, rocky cliffs with a very strong current. With the exception of occasional patches cleared for cultivation, the banks were formed by most thickly-wooded hills, rising however to no very great height, with here and there a pretty Chukma village showing through the trees, the houses all being built of bamboo and with their floors raised on poles some 8 or 10 feet above the ground. A small steamer called the "Flame," of 14-horse power and drawing only 18 inches, had been sent from Calcutta for work on the upper part of the river, and she was placed between Rangamattea and Kassalong. At first she was used to tow large country boats, but later two flats for her arrived, and these could each carry 100 men and a large amount of commissariat supplies. The small boats or canoes called also dugouts, employed between Rangamattea and Burkul, would carry on an average 7 armed men, 10 coolies, or 20 cwt. of stores; they were furnished with light-arched coverings made of matting. Some

300 of these boats had been collected for the purposes of the expedition, and the monthly hire which had to be paid for them formed no small item of the total expenses incurred.

At Kassalong there was a considerable extent of level ground, sufficient to encamp at least two native regiments, and it possessed a small bazaar, which had been some time established with a view of opening a trade with the Lushaies. There was a police stockade; it was our most advanced post in this direction; the limit of our steamer communication up the river; and was known to be tolerably healthy. It was therefore determined to establish a depôt here. Hospital sheds capable of holding 150 sick, two large commissariat buildings, and rough huts to shelter about 700 men, were accordingly put in hand. These works were carried out by hill coolies, collected much against their will by the civil authorities. The neighbouring country fortunately abounded in bamboos; and it may be as well to explain how this most useful of forest trees is used for the floors, sides, and roof of a house. The female bamboo is hollow. A branch of sufficient size being selected, it is cut completely through at one part of the circumference down the whole length, whilst at other parts it is only cut half through in innumerable longitudinal slits. It is then opened out flat and thus forms a sort of flexible plank from 9″ to 12″ wide according to the size of the bamboo, and of course of the same length as the branch. These long broad slips are interlaced so as to form a sort of matting, which being made according to the size required, is lifted bodily into its place on the roof or the wall, or wherever it may be. Each regiment was to have a small store depôt at Kassalong, to contain the 2nd regimental reserve of small arm ammunition (which reserve was never required further to the front), and all articles of clothing, &c., which the troops had brought with them in excess of what was to be taken into the field. A reserve of boots and blankets was also formed, to be drawn on as required by the troops in front.

As it was possible the Howlongs might get round the right flank of the column and attempt an attack against this place, it was determined to leave here a garrison of one company with a British Officer in command. A road of about 8 miles in length had been opened out between Kassalong and Lower Burkul by the civil authorities. As it was impossible that all the troops could travel between these two places by river, owing to the greater number of the boats being required for the conveyance of commissariat supplies, a part of the force which proceeded by land had here an opportunity of forming some idea of what marching in the Lushaie country would be like.

To begin with, the natives on our frontier consider the course of a mountain stream an excellent road, and so long as the pools of water it contains are not more than three feet in depth, they do not think it requires in any way to be improved; in the next place, in crossing a hill range, the path is taken straight up one side and straight down the other, and the clay soil, kept in a state of moisture by the heavy dews, is so slippery, that to accomplish the descent of one of these hill-paths in safety it is often necessary to hold on by the trees alongside. This bit of road, with its constant ascents and descents, and the $2\frac{1}{2}$

miles in continuation to Upper Burkul, proved a trying march to begin with, both for troops and coolies.

From Lower to Upper Burkul, a distance of $2\frac{1}{2}$ miles, there are a succession of falls and rapids which render this part of the river unnavigable; and it was only with very great labour that some twenty of the smallest dugouts could be dragged up through the shallow water at the side of the river. The still smaller canoes which had principally to be used above Upper Burkul, could be dragged up with less difficulty, although to get some 300 of these passed up occupied considerable time. This proved the first break in our line of water communication. It was necessary to build sheds at Lower and Upper Burkul for the storage of commissariat supplies, and to place a small detachment of troops at each place. The first coolies that arrived had been put to work on the path between these two places to make it passable for laden elephants, and this was found to be a troublesome bit of road-making owing to the many watercourses across which the path had to be taken.

On the 8th November a party of 110 police, under a British Officer, had started by march from Upper Burkul to Demagree to clear ground there, and to commence work on the stockade which had been ordered. Demagree is in the country of our Lushaie ally, the Chief, Rutton Pooea, but the guides he furnished to the police either could not or would not show the way, and consequently they had to make a much longer march of it than necessary. The General with the 2nd Goorkha Regiment, left Chittagong on the 7th November, and on the 12th he arrived at Upper Burkul with the head-quarters and two companies of the regiment. Huts had been prepared for about 400 men, and the troops and coolies occupied these until arrangements for their further advance could be made. On the morning of the 13th, Rutton Pooea came in and had an interview with the General. He seemed rather anxious about the consequences to himself after we left the country, if he took part with us against the Syloos, as theirs being the stronger tribe, they would naturally retaliate when we were no longer there to assist him. He was however satisfied, on being assured that if he rendered us good service, he would not be deserted. He then made a demand for arms and ammunition, and said he would lead a war party at once against the common enemy. His demand had to be met evasively, and it was with some little difficulty he was made to understand that he would only be allowed to undertake military expeditions with the General's sanction, and that just now it was not considered advisable he should commence operations. We shall see further on that the military prowess of his tribe did not at any time prove of great advantage to us. He stated that the Syloos and Howlongs had had spies watching our collection of supplies, making of roads, &c., and that the tribes had come to the conclusion we should never get so far as their villages, but if we did, they intended to fight to the last. He warned us that we might be attacked on our right flank, on our advance to Demagree, by Howlongs. Rutton Pooea and his few attendants being the first Lushaies we had seen, were naturally observed with much interest, and their fondness for rum and the

amount they could drink without being in the least affected, were matters of considerable astonishment. In fact they had to be put on a limited allowance, both for their own sakes and because as yet we had not been able to get many casks of spirits so far up country. The Chief himself was but little better dressed than his followers; his appearance was not prepossessing; he had a crafty eye, and his stolid, immoveable, and somewhat heavy features, gave but little indication of the thoughts passing through his mind. The General hoped however he would prove a useful ally, and looked to him to furnish us with guides and information, and also as a possible go-between in our communications with the enemy. There had been great difficulty in procuring interpreters, but Captain Lewin the Political Officer, had collected all that were available, and these consisted of five men. The interpreters specially provided for the General consisted of two men, one of whom translated the Lushaie language into Bengalee, and the other interpreted the Bengalee into bad Hindostani; it may be imagined therefore, that it was no very easy matter to carry on a conversation with a Lushaie through such a medium.

An exploration for some few miles of the line of country which would have to be followed in an advance on Demagree, made it evident that to open out a road to that place for laden elephants, would require more time and labour than could be devoted to it, and it was therefore decided, to make simply a path which could be traversed by troops and by unladen elephants, and to keep to the river for the line of communication for supplies. The company of Sappers which reached Upper Burkul on the 14th, two companies of Goorkhas, and some 400 coolies, were put to work on the path to Demagree, which was marked out by the first detachment of troops which proceeded to that place, an account of whose march will be given presently.

The canoes used on the river above Upper Burkul, consisted of small cranky boats, in which it was necessary to sit quite still to prevent their upsetting. Attempts were made to form them into rafts, by fastening two together with a platform, but it was found impossible, when thus connected, to get them through the rapids, and it was therefore necessary to use them singly. Actual experiment showed that, besides the two hill men who managed the canoe, each would take on an average, four armed men, or 5 cwt. of commissariat stores. On the 16th, the General, the Political Officer and one company of Goorkhas, started by boat from Upper Burkul, taking with them 50 canoes laden with supplies. The first day, during which many small and not difficult rapids were encountered, Ootun Chuttra was reached. At this place the rapids were difficult and of considerable extent, and only small canoes could be passed over them. It was therefore determined to use the dugouts, and also a certain number of canoes so far only, and to establish there a depôt with stockade and small garrison. Subsequently, when more coolies became available a path was made, and a porterage established alongside these rapids. The second day, the fleet of canoes reached Demagree, the only difficulty experienced being some rapids just below that place, through which subsequently the Sappers made an easy passage.

The same day that the General left Burkul, a detachment of two companies of the 2nd Goorkhas, with 250 coolies, of whom 175 carried rations, and the remainder working tools and baggage, accompanied by Rutton Pooea and his followers as guides, commenced their march towards Demagree. The distance between these two places is probably 35 miles, and to accomplish this, although working hard from daylight until seven or eight at night, it took the detachment five days. The five marches then made were afterwards divided into four. One considerable river and three mountain ranges had to be crossed, and the latter, although not exceeding 2,000 feet in height, were steep and difficult. For more than half the distance the track led along the beds of small rivers, with the water often more than knee-deep, and this proved the pleasantest part of the march. The river-bed was generally of fine gravel or sand ; at some places however, it consisted of soft black mud, whilst at others, the troops and coolies had to struggle as best they could over large slippery boulders. When the river-courses were left, it was to take some short cut across a steep hill or to ascend a mountain range, the clay slopes of which, moistened by the dew, and still further wetted by the feet of the troops as they left the rivers, proved so difficult for the coolies, that regular steps had to be cut on them. The dew was so heavy, that at night after condensing on the trees above, it pattered down on the roofs of our small sheds like rain, and as the sun can rarely penetrate through the dense foliage of large forest trees, bamboos, and underwood, the ground remains in a constant state of moisture. The river crossed is called the Thega, and is a tributary of the Kurnafoolie. It has a width of from 35 to 40 yards, and a suspension bridge 50 yards in length and 40 feet above the water, constructed entirely of long creepers and bamboos, had been thrown across it by the Lushaies. We learnt that this structure has to be rebuilt every year, but that this year it had not been done. As the creepers appeared exceedingly dry and brittle, it was considered advisable not to send laden coolies over it. After searching for some time, a ford not exceeding 2 feet 6 inches in depth was found, and marked off with long stakes. Fortunately where the ford existed, there was a firm sandy bottom, and consequently all that was required to render the passage practicable for elephants was to make paths down the steep banks of the river to the water's edge.

One day's march was much like another, and may be described briefly as follows :—At daybreak the men lit fires and cooked a meal, and as soon as this was eaten the march commenced, and having been warned that we might be attacked on the road it had to be conducted with all military precautions. An advanced guard of about 30 men, accompanied by 40 or 50 coolies with axes, picks, and shovels, started an hour before the rest and cleared away trees which had fallen across the path, improved ascents and descents, which were particularly difficult, and closed with branches of trees all paths to the right or left which would have led the main body off the direct road. It was found utterly impossible to send out flanking parties ; although tried on one or two occasions, it was with the invariable result of the flankers being lost in the dense woods through

which we marched, and our having to delay whilst men were sent out to find them. It was often impossible to see for twenty yards on either side, and the march had therefore to be made in single file, with a strong rear-guard to bring up straggling coolies. Between two and three in the afternoon, the advance halted on the most suitable ground that could be found near water, and troops and coolies, as they came up, were set to work to cut away small trees and underwood. As soon as sufficient room for the huts and an open space round the encampment had been cleared, materials for building were collected. The sheds for the men consisted of a long sloping roof, covered with bamboo leaves, or other convenient foliage, with one side resting on the ground and the other on supports about 5 feet high. A layer of bamboo leaves, with a waterproof sheet spread on the top, proved an excellent bed. Some half-dozen Chukma coolies, who were clever at this sort of rough building, were sent with the detachment to show our men the best way to set to work, and soon taught them how to fasten the different parts of their sheds together with a sort of very flexible withy made from the bamboo. Four of these Chukma coolies could build a very comfortable hut to hold the three Officers with the detachment, in half-an-hour. The coolie sheds were generally placed in the centre, and those of the troops outside; pickets were posted as soon as sufficient space had been cleared, and the ground in front of them was covered with a rough abattis formed with the timber which had been cut down. In a short time the troops became very handy at hutting themselves, and it was wonderful to see, in the space of three hours a large extent of ground covered with trees of all sizes and thick underwood, converted into a broad open space, on which long lines of sheds were to be seen, with the men scattered about cooking their evening meal. It was sometimes late at night before the rear-guard arrived, and then owing to the exceeding darkness, it was necessary to distribute torches along the line of march. As the wood was all too damp to burn with a bright flame, these were made by wrapping pieces of cotton cloth round the end of a stick, and covering the cloth with ghee from the supply which had been provided for the men's rations. Leeches were here very troublesome, and perhaps every half-hour it would be necessary to pick three or four off one's legs. Not only did they attack our legs and feet, but in some extraordinary way they used to be found up one's sleeves, or on one's back; how they managed to get there remained an unsolved mystery. On the last day of the march the detachment ascended the Oheepoom range, and marched through Rutton Pooea's chief village, which was the first that had been met with since leaving Burkul. It contained about 150 houses, abounded in pigs, fowls, and dogs, and was tolerably clean. From the summit of the mountain on which it is situated, an extensive view of the Lushaie country was obtained. Range after range of densely-wooded hills stretched away into the far distance; here and there perched on high and apparently inaccessible hill tops, were to be seen the villages of the two tribes we had come to punish, whilst on the slopes below them lay patches of joom land, covered with ripe yellow crops.

The system of cultivation pursued by the Lushaies is called

jooming, and their cultivated land, jooms. The site of a village is selected with reference to the suitability of the adjacent ground for cultivation. After the annual rains have well ceased, or about the beginning of November a certain extent of land is selected, on which all the trees are cut down and left on the ground to dry until February or the beginning of March, when they are burnt. Holes are then made in the ground, into which the five principal seeds employed are placed, and these in due course, bring forth a rich and plentiful crop; the cotton grown is remarkably fine, and the rice is particularly good. The same process is repeated on a fresh site every season, and as at the end of ten years the land within convenient distance of a village becomes by this means impoverished, fresh ground has to be chosen, and to this the inhabitants move off bodily with bag and baggage.

The site selected for the Demagree depôt was at the northern end of the Oheepoom range, immediately below some extensive rapids and falls, where the river opens out into a fine circular basin 300 yards in diameter. The police sent on in advance had cleared a certain extent of ground on the left bank, and erected a small stockade. As Demagree must necessarily be the starting-point for operations against the Syloos and Southern Howlongs, and was to contain the advanced hospital and large commissariat supplies, it would evidently have to be occupied by somewhat considerable numbers until the close of operations. To prevent overcrowding and to secure proper sanitary arrangements, it was therefore necessary to clear a large extent of ground. To do this, magnificent forest trees bound together by innumerable long creepers, had to be cut down, and such was the tenacity of these creepers, that at times eight or ten large-sized trees with the trunks completely cut through near the ground, would be seen swinging in the air, and could only with great difficulty be brought down after some of the larger creepers had been severed. In fact, although the labour of cutting down very large trees did not compensate for the trouble entailed, it was often necessary they should be destroyed in order to get down the many smaller trees suspended to them. A hospital to hold 120 sick, rough huts to shelter 500 troops and 500 coolies, and a large commissariat shed, were at once put in hand; a small magazine to hold the 1st regimental reserve of ammunition was built; a bamboo bridge was thrown across the river where it narrows near the falls, and on the other side space was cleared for elephant lines and for the hill coolies employed on the boat service, and a small commissariat hut was erected. A stockade was built on the hill above, and a good path made from it to Demagree. All these works and the road-making to the front, kept the troops and coolies, as they arrived in successive detachments, hard at work.

To assist in building sheds, but principally to be employed in working the fleet of boats above Burkul, some 500 villagers had been collected from our hill tracts and from the country about Bindabun. These men came much against their will, as they disliked being taken from their own agricultural pursuits, and had a most unreasonable fear of the Lushaies. After making one or two voyages up the river, they began to desert in such numbers that it was to be feared the boat service on

which so much depended, would break down altogether. This proved an anxious time for the General, but owing to his urgent representations, Mr. Hankey, the Commissioner, and the civil authorities under him, went to work with such good will that matters soon began to wear a more promising appearance. An energetic officer, Captain Hood, was placed in charge of the hill coolies, police were sent out to bring back deserters who were sent up the river again, the administration of a few judicious floggings, and the enforced presence on the spot of some responsible head men of villages, brought about by degrees a satisfactory state of things. These men were, however, all along a source of some anxiety, and it was found necessary, in order that none of them might be kept too long away from their homes, which would have proved a legitimate ground for complaint, to have them relieved every two months. The Commissariat Department was obliged to undertake the feeding of them, a contingency which had not at all been expected, and had not been provided for, when calculating what supplies would be required for the use of the expedition.

On the 29th of November the Sapper company arrived at Demagree, and the Officer in command reported that the path so far had been made possible for unladen elephants. Troops had in the meantime been moving up in parties of two companies, and now all future detachments were ordered to bring up with them 10 elephants. Above Demagree many explorations of the neighbouring country had been made to find out the best line to take in advance for an elephant path. An ascent of the left bank, where precipitous rocky cliffs were found, showed that side to be utterly impracticable. Across the river the ground was very difficult and the jungle exceedingly dense, but a tolerable line of road was opened out and made into a path passable for laden elephants in about 14 days' time. This path was taken for $4\frac{1}{2}$ miles up the river to a point where, after all the rapids had been passed, it again became navigable. But for the river work above, it was no easy matter to get the canoes up. A slide was constructed alongside the principal fall, but it proved both dangerous and difficult to pass the canoes up it. Owing to their fear of the Lushaies, it was utterly impossible to induce any of the hill coolies to work above Demagree, and had attempts been made to force them to do so, it was feared that the whole of them below that place would at once desert, with the approval of their head men. This work was therefore undertaken by the police, assisted by Punjabee coolies, and to them the line of boat service up the Sahjuck river was also afterwards entrusted.

Whilst remaining at Demagree preparing for a further advance, the General had tried to open communications with the Syloos, so that they might have an opportunity of complying with his demands before he advanced against them. Rutton Pooea had declared that he was on unfriendly terms with the tribe, and unable to send any messengers to them. He had old scores to pay off, and looked forward to their discomfiture with too much interest to permit of his rendering us any willing service on this occasion. He however assured us that the Syloos meant fighting, and that we should first meet them at the Sahjuck river, the passage of which they intended to defend. A Chief

named Lemshilong, who occupied a somewhat independent position and lived between Rutton Pooea and the Syloos, came into our camp, but being seized with a groundless fear of treachery, he suddenly fled and proceeded to join the latter tribe. The only messenger that could now be reckoned on was the head man of one of Rutton Pooea's villages named Lingorah, who had married the sister of a Syloo Chief, and he was therefore kept in charge by the Political Officer until our arrival in the enemy's country.

Towards the end of November a great deal of sickness began to prevail; many Officers and soldiers and about 300 coolies were ill with dysentery and fever, but neither of these diseases assumed a severe form. It had been intended originally that the guns, mortars, and equipment of the artillery should be carried on elephants, but as it would be impossible to delay the advance until practicable roads for these animals had been made, the General determined to employ instead coolie carriage; and owing to the sickness which had commenced, and the hard work the coolies already had to do in forwarding commissariat supplies, road making, &c., it was found impossible to take both the guns and mortars into the field, and the latter were therefore left at Demagree. The strength of the half battery to proceed to the front in the first instance consisted of 2 Officers, 21 gunners, 1 native doctor, 3 artificers, and 12 rank and file of 27th Punjab Infantry attached, and to carry their baggage, artificers' tools, tarpaulins, guns, and 42 rounds per gun 100 coolies were required. To each gun and to each carriage 6 men were detailed, of whom 4 carried and 2 acted as relief; each wheel required 2 men, and 3 coolies were told off to each box of ammunition containing 7 rounds. The strongest and most healthy coolies were selected and attached permanently to the battery. As regards the company of Sappers it was found, after reducing their equipment and working tools as far as possible, that they would require a total of 80 coolies, and a native regiment, according to the scale of carriage ordered by the Quartermaster-General, would have to be supplied with 220 men; in both of these cases it was possible later to reduce the number of coolies.

On the 30th November the distribution of the troops and coolies of the column was generally as follows:—At Demagree, the 2nd Goorkha regiment, the Sappers, and the half battery, and between 700 and 800 coolies; 2 companies 27th Punjab Infantry, and about 300 coolies on the march from Burkul to Demagree; at Upper Burkul 3½ companies, and at Lower Burkul half a company of 27th Punjab Infantry, with some 350 coolies between the two places; at Kasalong, the head-quarter wing of the 4th Goorkhas and 100 coolies, and at Rangamattea, the other wing, with 100 coolies. Having thus sufficient troops to the front, with those in the rear well on their way up country, the General was able to issue instructions for the advance of a detachment of the 2nd Goorkhas, under Major Macintyre, on the 1st December, the date on which the Commander-in-Chief had directed that operations should commence. Matters were not however on a sufficiently satisfactory footing along our whole line of communication up to Demagree, to allow of the General himself starting until some days later.

The Syloos being the tribe nearest to Demagree it was necessary to move first against them, and it was determined to proceed towards the large village of Vanoonah, about 15 miles distant as the crow flies, on the Rae Jan Klang range. The river Sahjuck, a tributary of the Kurnafoolie and the boundary in this direction of the Syloo country, flows along the foot of this range, and was known to be navigable for some miles. It was therefore decided to continue the line of communication for supplies, from the place to which the elephant-road on the right bank of the Kurnafoolie was making, up the rivers to a point on the Sahjuck, called Vanoonah's Ghat, whence a path led to the village of the same name, and in the meantime to find out the best line for troops, coolies, and elephants to march by. A tolerably direct path was fortunately discovered leading from the Kurnafoolie, $1\frac{1}{2}$ miles above where the boat service was again to begin, to Vanoonah's Ghat, and the distance to this place from Demagree was divided into two marches.

On the 3rd, head-quarters of 2nd Goorkhas and two companies marched from Demagree; on the 4th, they were joined by half of the Sapper company and Major Macintyre's detachment, and on the 5th they reached Vanoonah's Ghat. As there were no signs of an enemy on the opposite side of the Sahjuck, Colonel Macpherson, who was in command, set to work to clear ground on the left bank for a stockade and to throw a trestle bridge across the stream. The river here is about 35 yards wide, and except at the rapids some little distance below, which fortunately were not difficult, flows with a sluggish current; the banks, generally steep, are formed by the lower features of high mountain ranges, and are densely wooded to the water's edge. By the 9th the whole of the 27th Punjab Infantry had arrived at Demagree, and one wing, with the remaining half company of Sappers, had been stationed in working parties along the road above that place. Arrangements had been completed for the boat service up the Sahjuck, and the General was therefore able on that date to move forward himself, and on the 10th, Brigade Head-quarters arrived at Vanoonah's Ghat with the artillery and two more companies of the 2nd Goorkhas.

From a hill a little way above the river, a considerable force of armed men could be clearly seen with glasses in Vanoonah's village, and at night large fires, evidently intended as signals were lighted in its vicinity. On the 11th the head-quarter wing of 2nd Goorkhas passed the river, ascended the opposite ridge for about $4\frac{1}{2}$ miles, and occupied a fine open spur without opposition. From this position, Lingorah who has been previously mentioned, as being married to the daughter of a Syloo chief, was sent with a message towards Vanoonah's village, in order that the enemy might have an opportunity of submitting to our terms, should they wish to do so. He soon returned, not having been allowed to pass the Syloo pickets, but he was there told that no communication would be held with us unless we at once retired, that five chiefs were assembled with their followers, and that if we attempted to advance, the consequences to us would be something terrible. Lingorah had been put in a great fright, as the Syloos warned him that as soon as they had settled with us, they meant to have his head

as a punishment for having joined us. On the afternoon of the 13th the fleet of 25 rafts with 200 maunds (1 maund = 80 lbs.) reached Vanoonah's Ghat. It had started on the 11th, and therefore took two days for the voyage. Every raft carried two armed men, as an attack from the river bank which might most easily have been made, had been expected, and it was therefore a great relief to find the fleet arrive in safety, and also that the rapids on the Sahjuck had not proved so difficult as was feared. This raft service continued for the future to be worked by police and coolies under the orders of Mr. Crouch of the police. Those of his men who had been stationed at Ootun Chuttra were relieved by a party of the 4th Goorkhas, and moved up to Vanoonah's Ghat. On arrival of the fleet, orders were sent to move the coolies to the front from the line of road between the two rivers, in order that they might work in advance of the Sahjuck.

On the 14th two parties of 2nd Goorkhas of 80 men each, under Colonel Macpherson and Major Macintyre respectively, were sent out to feel for the enemy, and to reconnoitre paths by which the advance against Vanoonah's village could be made. Major Macintyre proceeded for a considerable distance, had a brisk skirmish with the enemy, who retired at his approach, and having completed the duty on which he had been ordered, returned to camp. As soon apparently, as the firing of shots was heard at the village, it was set fire to by the inhabitants, and the greater part of it was rapidly burnt down. Colonel Macpherson had taken a difficult and circuitous direction, in the hope that a path might be found by which the enemy's position on the ridge could be turned. Although the line of country he followed was so thickly wooded as to leave him uncertain if he was advancing in the right direction, so well was his object fulfilled that he suddenly found himself entering on open ground some few hundred yards to the left rear of the enemy's position at the village. The few armed Syloos that were seen being mistaken at first for men of Major Macintyre's party, the advance was continued. The commencement of firing and the sudden rush of the people to arms, soon made it evident that the enemy was still in occupation, but as they appeared to be unprepared for defence, and quite taken by surprise, Colonel Macpherson pushed quickly onwards in skirmishing order, and carried the village without a single casualty. The enemy lost many killed and wounded, all of whom however, they managed to carry off in the precipitate flight they made. Several guns and spears were found, but so quickly did the Syloos disappear into the thick woods on the further side of the village, that it had been impossible to take a single prisoner. It appeared that when Major Macintyre's party returned to camp, the Chiefs concluded they had driven it back, and proceeded to refresh themselves at the village, and when Colonel Macpherson, whose advance they had not discovered, arrived, they were all comfortably seated at dinner from which they doubtless thought themselves most rudely disturbed.

The following day the site of the village and its few remaining houses were occupied by two companies of 2nd Goorkhas, a stockade was commenced, and the Sappers put to work on the path leading up the hill. Twenty elephants were on their way from Demagree to work this part

of our line of communication, and pending their arrival, embankments were made in the small watercourses so as to form reservoirs. Whilst necessarily halting for a few days on the Belkai Jooms, the reports which reached the General from the rear were the cause of considerable anxiety. The hill coolies' business had not then been satisfactorily settled, and they continued to desert in large numbers; a batch of 300 Nepaulese coolies, whose services now would have been most useful at the front, had arrived on the 7th December at Chittagong, and cholera in rather a severe form had broken out amongst them; and although these coolies were isolated and moved off the line of communication as soon as possible, cholera spread as far up as Demagree, in the neighbourhood of which place a company of the 4th Goorkhas suffered severely. It therefore became necessary not only to isolate the Nepaulese, but other detachments of coolies and troops, until the disease had disappeared, a measure which much interfered with the progress of the expedition.

In the neighbourhood of Vanoonah's village large stores of unhusked rice were found in the joom-houses or barns of the Lushaies. Endeavours were made to turn this rice to account for the use of troops and coolies, but the labour of drying and husking it by people unaccustomed to the work, did not repay either the time or trouble required. It was therefore determined to preserve all the rice that was found near our line of communication for the use of the elephants, and to destroy the remainder.

On the 18th the head-quarters and two companies of the 2nd Goorkhas at the Belkai Jooms were ordered up to Vanoonah's village. As they were falling in, several shots were heard about 500 yards from the camp. A half-company at once went out and came upon a party of about 25 retreating Lushaies, on whom they inflicted considerable loss. The firing heard had come from this party which had laid in ambush on the road in rear of our position, and had fired on three Goorkhas, bringing the post bag from Vanoonah's Ghat. One of the Goorkhas received five mortal wounds, and his two comrades kneeling beside him and firing alternately, kept the enemy in check until assistance arrived. The plucky behaviour of these two Goorkhas was rewarded subsequently by the bestowal of the decoration of the Indian Order of Merit, which carries with it a small pension. About the same time the Lushaies began firing at the men sent down from Vanoonah's village to the small trickling stream below for water, but a few Goorkhas hidden in the neighbourhood kept such a sharp look out, and the enemy showed such a dislike to the whiz of their bullets, that they soon gave up these petty attacks. The Lushaie idea of warfare is to place an ambuscade having an easy retreat, so that if the enemy does not retire on receiving their fire, they can themselves do so, and as in all their endeavours in this line they were finding themselves beaten, the moral effect on them was disheartening in the extreme, and was probably the cause of their not making afterwards a more active resistance to our advance. Fortunately, the Goorkha is a soldier of excellent nerve; he rarely loses his presence of mind, and never throws away a shot; had we commenced the advance with troops who had wavered or shown the least indecision,

or who had allowed the enemy to gain the smallest advantage, even to the carrying away of one head as a trophy, we should have undoubtedly encountered afterwards a more lively opposition, especially along our line of communication. The Goorkha is also very quick and intelligent; in marching to the attack we always proceeded in perfect silence, the leading files peering right and left, and holding their rifles ready for a snap shot should they catch sight of an enemy; words of command were given in an undertone and no matter what the length of our line might be, they were always correctly passed and at once acted on.

On the 19th, brigade head-quarters were established at Vanoonah's village. Endeavours had in the meantime been made to obtain information of the villages and paths in front, but with very limited success. From the summit of the Rae Jan Klang, the village of Savoonga, the Chief of the tribe, could be faintly seen, apparently on the fourth range to the north-east, and to that point the General determined to advance, destroying as he went all villages to his right and left that would not submit, and burning their stores of grain.

On the day the brigade head-quarters arrived at Vanoonah's, Colonel Macpherson started with a detachment of his regiment to attack Lal Hleera's, a village due east, on the summit of the next range and as the crow flies, only six miles distant. Owing to the difficulty of the path, he did not reach it until the morning of the third day. The men leading his advance were fired at the second day, but so thick was the forest that no enemy could be seen. In the night the inhabitants burnt down the village, although on the approach of the troops the following morning, they kept up a brisk fire for several minutes. All that was found on the site of the village and neighbourhood were many fowls and pigs, the latter being acceptable to the low caste coolies. During the remainder of the day, the troops were employed in burning all store-houses in the neighbourhood. By signalling with flags back to the General, Colonel Macpherson obtained permission to proceed to the range to the east to destroy other villages. The summit of this he reached in one day, the enemy having opened a heavy fire from the opposite bank of a river which had to be crossed, but offering no opposition at their villages, from which they fled on the approach of our troops. The detachment stayed a night at Lalpooethal, the furthest village reached, where many hundred fowls and goats and gayals were secured. The next day the troops returned to Lal Hleera's, destroying as they marched numerous storehouses of grain, and on the morning of the 25th reached Vanoonah's, having during their absence burnt some 10,000 maunds of rice, and carried off the greater part of the live stock of three large villages, the total destruction of the same being also caused. Some ten or twelve of the enemy were seen to have been wounded, but as it was only on the open ground near their villages that a sight was ever obtained of them, and then only for a very short time, it was found impossible to inflict any very severe loss on them.

On the 20th, Major Macintyre had proceeded with a detachment in a north-easterly direction, and returned on the 23rd. He had carried with a rush a stockade which the Lushaies made a feeble effort to defend,

and had advanced so rapidly that the enemy had barely time to vacate their villages, much less to carry off any of their property. He burnt two large villages, destroyed over 8,000 maunds of rice, and captured 40 gayal. These gayal, a sort of domesticated bison, are of great value to the Lushaies. They are allowed to wander about the woods during the day to feed themselves, but at night they always return to their village to lick salt of which they are very fond. The flesh of these animals was found coarse and somewhat indigestible; as the Lushaies look upon milk as an excrement, the gayal are merely used by them for food, and one or more of these animals are always slaughtered on festive occasions.

On the 26th, a detachment of 100 men marched along the ridge in a northerly direction for 12 miles, and occupied the site of an old village; the path was tolerably level, but in parts extremely rocky and dangerous for laden coolies. The following day brigade head-quarters with head-quarters of 2nd Goorkhas, the Sapper company and 250 coolies carrying supplies, proceeded to the same site, but so difficult was the road, that many coolies did not arrive until the following morning. It was found necessary afterwards to divide this march into two stages; a great deal of labour was expended on the road to make it passable for laden elephants, notwithstanding this however, two elephants fell over, one of which was killed, and the other so injured as to be of no further use.

The post there established was called Kotheer Klang, and as would naturally be the case on a mountain ridge, the water supply was scanty. Endeavours were made to form reservoirs, but only with partial success. A stockade was built, as was done at every permanent post established, and in it a platform for commissariat stores, and huts for a garrison of one company and a certain number of coolies were constructed. These stockades were made on commanding ground, and a space cleared round them; their shape was irregular, and they were formed by logs about 6 inches in diameter placed horizontally between uprights some 7 feet high, driven firmly into the ground and fastened together by withies. Endeavours were made to find a path from Kotheer Klang to the river, so that the line of supply up the Sahjuck might be prolonged, but the country was so difficult, and the water in the river falling so rapidly, that the idea of making further use of water communication had to be abandoned.

The work of destruction still continued, and every day large fires of burning storehouses were to be seen on the hill sides. The labour thereby entailed on the troops owing to the nature of the country was exceedingly severe. It was learnt afterwards, that when the news of the damage being inflicted on the Syloos reached Calcutta, a great outcry was raised by some of the newspapers against what was called the barbarity and cruelty of such proceedings; but it can hardly be necessary to explain to a military audience, that if an enemy will not stand to try his fate in open fight, an assailant must then follow the only alternative there is, and inflict what injury and destruction are possible on his provisions and stores, until he comes to terms. But already the General was anxiously hoping, that as the Syloos did not seem to have

much heart for fighting, they would give in, and the destruction of their stores of rice be no more necessary, for it was evident, that if continued much longer, the whole tribe, men, women, and children, would be reduced to very great extremities. On the 28th Major Macintyre was sent out with 100 men for three days to destroy two villages to our north. Beyond these two villages, the country was for some twenty or thirty miles uninhabited. With him he took large placards written in the Bengalee and Burmese characters, inviting the Syloos to come in, and promising that when they did so, all further destruction should cease. He attempted through interpreters to parley with the enemy, but only got fired at for his pains. In fact, at the villages he destroyed he experienced rather more opposition than usual, and it could only be concluded that the Syloos had as yet no intention of coming to terms.

On the 30th December, brigade head-quarters with a detachment of Goorkhas marched in an easterly direction for about six miles across a watershed, and arrived without opposition at the village of Lower Hoolien, which had been deserted by the inhabitants. The direct road to Savoonga's evidently lay through a village named Lul Schumah, to the right of the line we had taken, for this had been set on fire as soon as our forward movement was learnt by the enemy. The huts at Lower Hoolien, although somewhat dirty and terribly overrun by rats, proved most comfortable dwellings, and there were sufficient of them to accommodate the 2nd Goorkhas, Royal Artillery, Sappers, and several hundred coolies. Hitherto Rutton Pooea and his very nondescript contingent of some forty or fifty men, had marched with brigade head-quarters, and had been principally remarkable for getting in other people's way on the line of march. His followers had been very ready with excuses when it was proposed they should go out to burn joom-houses or to attack the enemy. At last, from Lower Hoolien, whilst the Goorkhas went in one direction, Rutton Pooea's men went in another to try and do some damage to the Syloos. They were so unfortunate as to get one man shot dead and another wounded, which damped their military ardour considerably. They cut off the head and hands of their deceased comrade to carry to his home, as they said his relatives would not believe in his death unless shown some satisfactory proof of the same. It also appeared necessary that a considerable number of Rutton Pooea's followers should proceed as witnesses to the village of the deceased man, and the consequence was that our ally's contingent found itself reduced to some fifteen or twenty men. Their dirty habits and excessive fondness for pork were so offensive to our native troops, that we were very glad to get rid of them. It must be remembered that Rutton Pooea is the chief who at his first interview with the General, could only with difficulty be dissuaded from starting off with a large war party of his tribe to attack the enemy.

On the 31st December, Major Macintyre was sent with fifty men against the small village of Upper Hoolien on the hill above us, at about three miles distance. Close to it he found a strong stockade, from which the enemy fired one volley, and then ran. He had one man wounded, but it was extraordinary that no more were hurt, for large baskets of

stones and trunks of trees suspended and balanced by creepers across the narrow ridge which led to the stockade, were let fall as his men advanced, but the Syloos, not having courage to let our troops get near them, cut the creepers too soon, and the trees and stones fell harmlessly to the ground. The village was found to contain blacksmiths' forges, and appliances which were supposed to be used in their manufacture of gunpowder, and apparently belonged to a community of artisans.

They certainly gave proof of great ingenuity in being able to manufacture gunpowder at all; but what they made was very miserable stuff, although sufficiently good for the guns from which it was fired. These consisted of barrels with the Tower mark and flint locks fitted to long awkward stocks. They generally loaded with three or four small bullets of beaten iron, and as may be supposed, with such charges they were able to do but little execution.

On the 1st January, 1872, the general distribution of the column was as follows:—4th Goorkhas, at Kassalong, Lower and Upper Burkul, Ootun Chuttra, and Demagree; 27th Punjab Infantry, three companies at Demagree, and the remainder of the regiment holding posts up to and at Belkai Jooms, with half company of Sappers working on the roads near that place; one wing of 2nd Goorkhas occupying Vanoonah's village and posts, thence to Lower Hoolien, at which latter place were the head-quarters of the regiment and three companies, the artillery, and half company of sappers; the remaining company of this regiment at Upper Hoolien. On this date there were, with the column, 1,600 effective coolies, of which number 1,300 at and in front of Demagree; 310 coolies in quarantine on account of cholera, and 512 sick, making a total of 2,422; it is to be noticed that just one-third of our means of transport was at this time unavailable. Orders were now issued to send back to Kassalong, and if necessary to Calcutta, all men not likely to be well enough to resume work within a specified time; but the others likely to be only some five or six days in hospital, could not be sent to the rear, and had to be treated where they fell sick. So that not only were sick coolies useless as regards work, but as every morsel of food they ate had to be brought up from the rear, they proved a very serious burden, and prevented the rapid accumulation of supplies at the principal posts along our line of advance, which the General had been anxious to secure.

About this time, some of Rutton Pooea's men were sent to the Howlongs through Demagree, to let them know how matters had so far proceeded with the Syloos, and what was required from them if they wished to avoid similar treatment. It was anticipated that they would not be able to return under twelve days or a fortnight.

On the 2nd January, brigade head-quarters and all the troops at Lower Hoolien, with the exception of a small detachment, moved to Upper Hoolien. The hill top to the north of this village, has an elevation above the sea of 4,478 feet, and to this the General proceeded to reconnoitre the country to the north and east of which we had been able to acquire the most scanty information, and to determine on the line of advance to be followed to Savoonga's, and

on any smaller operations it might be necessary to undertake in the meantime. An extensive view was obtained, which in the early morning had a somewhat extraordinary character. Between the many mountain ranges, which could hence be overlooked, and following the long winding river courses, were to be seen dense, almost motionless masses of white, cloudlike vapour, having much the appearance of huge layers of cotton wool. This thick mist covered the valleys, the summits of successive mountain ranges rising like so many islands above it. Sometimes a current of air would carry a flood of this vapour across the lower part of a mountain range into the valley beyond, into which it would flow down with the slow and solemn movement of molten lava. This mist generally cleared off at about eleven o'clock, when the view obtained was one of exceeding beauty. The evening effects, however were the most striking; the warm glow of the setting sun then spread a mellow softness over the distant mountain ranges, in the middle distance would be seen the deep purple gloom of the shady valleys, whilst in the foreground rich, tangled, and luxuriant masses of tropical vegetation completed a scene of surpassing loveliness. Orchids, tree ferns, and creepers of wonderful size and length abounded, and it is a matter of regret that the botanist, who the General was informed, would be attached to the Expedition, never put in an appearance. The Lushaies had all their villages on the hill tops, and not a habitation was to be seen in the low-lying unhealthy ground near the rivers. Although the General kept his line of advance as far as possible along hill ranges, both for the sake of salubrity and because the ground was easier, still as we had to move from west to east, whilst the mountain ranges ran north and south, it was impossible to avoid having a few posts in the valleys. The men in occupation of these posts were, however, not allowed to remain there long, and it was not found that a short sojourn had any immediately bad effect on their health. From the General's post of observation, extensive encampments of the people who had fled their villages could be seen far down in the valley below, and he determined to try to surprise one of these; two large villages were observed on the same ridge, the furthest of which was about 15 miles to the north, and he decided to destroy these before proceeding to the east against Savoonga.

A detachment of the 2nd Goorkhas of 100 men, under Captain Battye, was at once sent on, and the result of his march became very evident in the evening by the large fire seen at the first village, which was in flames. The following day, Colonel Macpherson proceeded with head-quarters of his regiment, and the day after, having been joined by Captain Battye, he reached the large stockaded village of Lal Gnoora, one of Savoonga's sons. A heavy fire was kept up for some minutes on the part of the stockade to be attacked, and under cover of this a storming party rushed up, cut down an opening with their kookries, and in a few moments were inside. Major Macintyre climbed over the stockade, and was the first man within the enemy's works. In the assault, one Goorkha was killed and one Officer and seven men wounded. Although there were two inner entrenchments, the Lushaies only defended the outer stockade, and

then vacated the village with their usual precipitation, and with one exception managed to carry off their killed and wounded, which however as far as could be known, were few in number. The next day all the rice stores on the neighbouring hillsides, which had been very extensively cultivated, were destroyed by the Goorkhas, and the village was burnt.

Owing to so many coolies having become inefficient through sickness, the 2nd Goorkhas took with them no baggage coolies on this occasion, and indeed for the rest of the campaign, with the exception of their cooking-pots, the men of this regiment carried the whole of the kits. It must be remembered that in India neither the British nor the native soldier carries on service more than his arms and ammunition. The detachment which was sent to surprise the Lushaie encampment was out from five in the morning until seven at night, but unfortunately the result of a very severe day's work was not successful, the enemy having discovered their approach just in time to effect his escape.

In the meantime, Syloo messengers had approached, by night, the pickets at Upper Hoolien, and said that the Chief Savoonga wished to give in, and that he would make his personal submission as soon as the elephants' tusks, which it was usual to present on such an occasion arrived. The General had them assured that he would be very glad to receive the Chief, and that as soon as he appeared no further harm should be done to them or their property, but at the same time let them know that he had no intention of staying his advance until the Chief actually arrived. A report was now received from the Civil authorities at Rangamattea, that an attack was expected on Kassalong. Colonel Tytler had been placed in command at and below Demagree, and had strengthened that post, and as it was held by such good troops as the 4th Goorkhas, the General felt no anxiety as to the result of any attempt the Howlongs might make on his rear.

It had been impossible to obtain the slightest information as to the line of advance which should be taken to Savoonga's. The General decided to make in the first instance to a village lying directly between that place and Upper Hoolien, on the summit of the next range to the east, and reconnoitring parties were sent out which, after much time and labour discovered a path leading to it, but it proved to be one of too great difficulty to be continued for our permanent line of supply. On the 6th, brigade head-quarters, with two companies Goorkhas, the artillery, and half Sapper company started for this village, which was called Lal Ngoor, but so precipitous was the path in places, that it was only with the greatest labour and difficulty that the guns and provision-coolies could perform the march. The distance was seven miles, which it took the head of the column as many hours to accomplish, and the rear-guard did not arrive until some hours later. To give a proper description of this march, I cannot do better than quote the General's own words, as they appear in his despatch published in the *London Gazette*:—"Where the path did not ascend or descend at an angle of "35°, it followed the tortuous bed of a mountain torrent, overhung by "trees and precipices, and blocked up with rocks and boulders, through "which we waded and stumbled for three miles, chilled by the cold

"clammy atmosphere, and feeling that fifty determined men might do "as they liked with us, for there was no possibility of protecting our "flanks." The immediate approach to the village lay along a spur, from which, at about 1,000 yards' distance, a good view was obtained of its defences, and at this point the General ordered the artillery to unlimber. A company of the Goorkhas, under Captain Nash, worked round under cover on the reverse side of the spur, and arrived close to the village unobserved by the enemy. As the first of our men rushed into it, two shells thrown with admirable precision, burst in its midst, and caused its immediate vacation by the enemy, who had commenced a brisk fire against Captain Nash's detachment. A pursuit was attempted, but as usual, the Syloos were able to hide at once in their thick woods without further trace being obtained of them.

We were now a good day's march from Savoonga's village, where it had been anticipated that a more determined defence would be made than had yet been experienced. But on the 7th, it was given to the flames which, although it did not look like giving in, made it doubtful as to whether the Chief of the Syloos intended fighting there or not. On the 9th, Colonel Macpherson and the head-quarters of his regiment rejoined the General from his expedition against Lal Gnoora's, and on the same day Upper Hoolien was burnt and abandoned, and our line of advance taken through Lal Schumah, by which place a better path had been found.

The rice stores in the neighbourhood of Lal Ngoor's having been destroyed, and sufficient commissariat stores collected at the front, the General advanced on the 11th January with 200 Goorkhas, the artillery, and half the Sapper company towards the site of Savoonga's village. It had been anticipated that this march might have been accomplished in one day, but as at half-past three in the afternoon a considerable distance yet remained to be done, and it was possible that serious opposition might be encountered, the General determined to bivouac for the night. The column had started at seven A.M., and for six hours the path had led along the bed of a rocky, and at times difficult stream. So damp was the ground where the bivouac was formed, that it was almost impossible to find wood that would burn. Although all were pretty well accustomed by this time to roughing it, the night passed here was one of extreme discomfort, and to guard as far as possible against evil consequences, every soldier and coolie was given the next morning a dose of quinine. On the 12th, after a steep ascent of two hours, Savoonga's was reached, a few of the enemy being seen retiring into the woods as our troops emerged on open ground. The men at once set to work to hut themselves, but this was found no easy business, for not a stick of the village was remaining, and as a considerable extent of ground in the neighbourhood had been cleared for cultivation, building materials had to be brought from some distance.

Savoonga's village, on the site of which the foundations of nearly 500 houses were counted, had been built on an extensive mountain ridge, 3,221 feet above the sea; it was over 70 miles by the road followed from Demagree. From a hill top in its immediate neighbour-

hood, a large extent of the Howlong country could be seen; ten large villages within four days' march were observed, and the ground in their neighbourhood was more open, cultivated, and with gentler slopes than the country hitherto traversed, and consequently promised well for the employment of rifle and artillery fire. Hitherto the firing of the troops had generally been snap shots at short ranges. Rutton Pooea had all along promised that as soon as we arrived at one march distance from the Howlong country, he would proceed to their nearest village and bring the Chiefs in, to make submission to the General. On the 13th the Political Officer, Captain Lewin, started with a detachment of 2nd Goorkhas and Rutton Pooea, to see the latter across the Dullesseree River, which forms the boundary of the Syloo country, and was about 4 miles from our camp. On the following day however he returned, Rutton Pooea having said he was afraid to proceed alone lest he should meet fugitive Syloos, and it had not been considered advisable by the General that any detachment of troops should enter the Howlong country until some communication had been held with them. On the 15th he proceeded by another route through Demagree, and was given 10 days by the General in which to bring an answer from the Howlong Chiefs. Mohamed Hassan, a soubadar of police, was sent with him to see that the journey was performed expeditiously, but was only to go as far as the neighbourhood of the first Howlong village, which he was not to enter.

As the Syloos still continued to fire on our escorts, and occasionally of a dark night to creep up to and fire on a picket sentry, one of our men being wounded one night within 20 yards of the General's hut, it was determined whilst awaiting the result of the mission to the Howlongs, to destroy the few remaining villages of the former tribe. Detachments were sent out, which burnt three villages and destroyed all their rice stores, and on the 20th the General, with 160 Goorkhas and the artillery, proceeded against the large village of Lal Jeeka, one of Savoonga's sons, and situated about 12 miles to our north. That night the troops bivouacked ; the following morning a strong stockade was reached, about 1½ miles from the village, and at the same time some large stones were let loose from the hill above, by which a few of our men were severely injured. The devoted Syloo who cut the suspending creeper was shot by a Goorkha, and rolled down the hill side after the stones he had let loose. A detachment of Goorkhas was sent to turn the stockade, and the guns were brought up to make an opening by which it could be stormed in front, but before they could open fire the enemy retired. As soon as the stockade was passed, the sound of crackling of burning wood and the sight of dense columns of smoke made it evident that the village, which could not yet be seen, had been set on fire. At about 1,000 yards a good view of it, and of considerable groups of armed Syloos, was obtained; the guns opened fire, and made excellent practice with common shell and shrapnel. It was curious to see the effect of these shells on the enemy: at the first one which fell near them, they evidently were so astounded as not to know what to do, at the second, they began to disperse and at the third, they fairly bolted and took cover under the

stockade. A few more rounds drove them thence, and the Goorkhas, on arriving at the village, found it completely evacuated. The defences were found to have been very ingeniously constructed; a loopholed stockade about 8 feet high, with small tambours judiciously placed, surrounded the whole village, the ascent to which was on all sides steep and difficult; large platforms, covered with stones, were placed at intervals outside the stockade, and were so balanced that by cutting a creeper, which led from them to the interior of the defences, their contents could be let loose on the heads of an attacking force. These platforms were afterwards destroyed by our troops, and the mass of stones which fell from them would have swept any number of assailants down the hill side. The village had contained about 250 houses, and we were fortunately able to save enough of these from the flames to afford shelter to the troops and coolies. On the 22nd, detachments were sent out to burn all granaries in the neighbourhood, and a party of Goorkhas proceeded to the north with some Officers of the Survey who wished to make a station in that direction. Although no Syloos could be discovered during the day, they crept up and fired on the picket sentries at night; so on the 23rd, when the General returned to Savoonga's, he left Colonel Macpherson with part of his regiment to await the return of the surveyors.

On his arrival a report reached him that Mary Winchester, the little English girl taken captive, had been given up by the Howlongs and was in Rutton Pooea's village, and that some of the Howlong Chiefs had already promised to bring in their captives as soon as they could be collected together. Owing to the extent of country occupied by that tribe, amongst the several villages of which the captives were known to be distributed, and to the fact that Mary Winchester had already been given up, the General determined not to advance against the Howlongs until the 30th. Before that date a report was received from the Soubadar of Police, who had entered the Howlong villages against express orders, that in the course of a few days the whole of the captives would be collected, but that if in the meantime our troops advanced the tribe would become alarmed, and he and Rutton Pooea would be in danger of their lives. This disobedience of the Police Soubadar caused the General great embarrassment; longer delay would allow time most favourable for military operations to slip away, and would be playing the enemy's game, whilst an immediate advance might possibly bring about the murder of our emissaries and cause fresh complications. Moreover, the hope was still clung to that the captives would be given up, and the necessity of such severe measures as had been taken against the Syloos, avoided. And it is to be noticed that although by this time every known village of the Syloos, to the number of 20, had been burnt, their granaries destroyed, and as much punishment inflicted on them as was possible, the recovery of the captives, which may be looked upon as the principal object of the expedition, had not been effected. What became of the captives when the Syloos determined to fight rather than surrender them was not known, although there were good grounds for supposing they were either murdered or exchanged to remoter tribes for firearms. When the

Syloos eventually gave in only one captive was forthcoming, and they solemnly declared that there were then no more in their hands.

Under these circumstances the General determined to await a report of the return of Mahomed Hassan to Demagree, but if the Chiefs and their captives did not arrive with him, to advance at once against the Howlongs. The time he was thus compelled to remain at Savoonga's, enabled a large depôt of commissariat stores to be collected there, and it was necessary that this should be done, as the number of coolies available would not allow of regular stages being established any further in advance, and consequently the greater part of the men carrying stores between Lal Schumah and Savoonga's would have to be taken off that part of our line, to proceed with provisions for the troops into the Howlong country. On the 1st February there were about 2,400 coolies with the column, of these 688 were sick, 300 were employed at and below Demagree for commissariat purposes, and the remainder, some 1,400, were in advance of that place; but of this latter number some 200 must be deducted who were engaged with the detachments sent out with the Survey Officers and with those which made expeditions of two or three days' duration to destroy granaries, &c., &c.; a few had also to be detailed for purposes of camp conservancy, &c. Twelve hundred coolies were thus available to work the three stages from Lal Schumah to Savoonga's, and to these men it was absolutely necessary to give occasionally a day's rest. Supplies, on the stages in rear of Lal Schumah, were forwarded either by boat or elephants. Coolies eat so much of their own loads, that they are the most unremunerative description of carriage it is possible to employ. For instance, each cooly carries 40 lbs., but he eats of this for his daily ration 3 lbs., that is taking into calculation the weight of rum casks, bags, &c., and allowing for the sirdars and mates who carried no loads; the second day the cooly returned empty-handed. and therefore of every 40 lbs. he took one march to the front he eat 6 lbs., and when his load, starting say from Lal Schumah, had made the three stages to Savoonga's it had been reduced to 22 lbs. At each post it was necessary to keep a company of Native Infantry, and supplies had of course to be left for them *en route*, and it consequently is not difficult to understand, that to collect a fortnight's supplies at Savoonga's, for the thousand men with which the General proposed advancing from that place, required a certain amount of time, and as it happened, abundant time was available for the purpose.

With coolies, the limit to which a rapid advance can be made is soon reached, and may be put down at six days; for a steady and continuous advance it is therefore absolutely necessary to work by a system of depôts which must be formed on a telescopic plan, that is to say, they must be larger nearer the base, and become gradually smaller the further they are advanced. It was found, for many reasons, more profitable to keep coolies employed on regular stages than to send them in a body from one end of the line of supply to the other.

The troops of the column were distributed as follows on the 1st February:—Head-quarters and four companies 4th Goorkhas at Demagree, the rest of the regiment holding posts below that place; the 27th

Punjab Infantry above Demagree holding posts as high up as Lal Schumah, and half company of Sappers keeping the elephant road in order; one company 2nd Goorkhas at Lal Ngoor, and the remainder of the regiment, the half company of Sappers, and the artillery, with brigade head-quarters at Savoonga's.

The Syloos had become very troublesome in the neighbourhood of Lal Schumah, firing repeatedly on escorts, and at night on the picket sentries, and the General had requested Colonel Doran to send out detachments of his regiment, the 27th Punjab Infantry, to try to find parties of the enemy in the woods, and to punish them. On the 4th, a detachment accompanied by Surgeon Smith—nearly all the combatant Officers of this regiment being sick—made a very successful raid. They came on a Syloo encampment, but the occupants being warned by their pickets, escaped before a shot could be fired. It being surmised that they would eventually return to the same place, our men remained near it in ambush for some time, when the enemy began to reappear. Some dozen or so were killed or wounded, and in the pursuit a girl was unfortunately badly shot, who with two women to attend on her, were taken back to our camp, where Dr. Smith had the satisfaction of bringing the wounded young woman on a fair way to recovery.

On the 8th a report was received from Colonel Tytler, saying that Rutton Pooea had returned, with assurances that the captives would at once be sent in by the Chiefs of the Southern Howlongs. The time had however now passed for promises, and moreover, the Northern Howlongs had made no signs of submission. The General therefore determined to advance. As was usual on this expedition, we had been able to get no information of the country to our front beyond what could be obtained by reconnoitring parties, but some of Rutton Pooea's followers had been able to tell the names of the largest villages that could be seen. The plan of advance on which the General decided was to move to the second range to the east, which appeared two fair marches off, to establish there a small stockade, and thence to operate successively in three different directions, proceeding in the first instance against the large villages of Benkoya and Sangboonga, who it was known were two of the principal chiefs concerned in the Cachar raids. The system of army signalling, which had on several occasions proved of the very greatest service, was found in the Lushaie country to be useful also for reconnoitring purposes. The flashes of sunlight thrown off a heliotrope, which are most brilliant on a clear day for a distance of 10 or 12 miles, would bring out the inhabitants of the village on which the heliotrope was directed, in crowds to gaze at it, and by this means it was discovered that the nearest Howlong villages had been abandoned by all but a few fighting men, whilst those at two or three marches distance were crowded with inhabitants.

As probably an advance against the Southern Howlongs would also be necessary, whose nearest villages were about four marches from Demagree, the General directed Colonel Tytler to have the path towards the village of the Chief Seipoya reconnoitred, and on it to establish two posts at intervals of a day's march, to collect

supplies in each of them, and to garrison each post with fifty Goorkhas. The General hoped thus to have all in readiness for a rapid advance against the Southern Howlongs, as soon as he returned from his expedition against the northern portion of the tribe. Three hundred fresh coolies were on their way to Demagree, who would be most useful for future operations, as amongst those in the advance scurvy was beginning to assume alarming proportions. The men of the 2nd Goorkhas, some of the Officers, and many coolies, were now suffering more or less from this disease. Nor is this to be wondered at, when we consider the continued hard work undergone; the deprivation, now for more than three months, of all descriptions of vegetables, milk, fresh meat, &c., and the nature of the climate in which operations had been carried on.

Owing to the continued hostility of the Syloos along our line of communication, it was not possible to reduce the garrisons of the several posts which had been established, and after providing for a detachment to be left at Savoonga's, deducting sick, &c., the General found he could advance against the Northern Howlongs with 300 fighting men of the 2nd Goorkhas, the artillery, and 20 Sappers.

It can hardly be asserted that it would have been prudent to proceed with a smaller force than this against a numerous tribe, having probably some 2,000 or 3,000 fighting men, into a country utterly unknown, where no supplies would be forthcoming, and where the length of time it would be necessary to remain was uncertain. To the few critics however, who condescended to write about the Lushaie expedition, it appeared that the force which had been detailed by the Commander-in-Chief was ridiculously in excess of requirements; various suggestions appeared in the papers, written by people who must have been entirely ignorant of the nature of the country and of the enemy, and even of the objects of the expedition, detailing with what force and in what manner operations should be carried on, and perhaps of these the most amusing was a recommendation contained in a letter to the *Times*, that 200 British sailors should be sent to make a rapid march through the country and to recover as they went all the captives. An exact detail of the troops, followers, and baggage coolies, with which General Brownlow advanced from Savoonga's is given in an Appendix; he took in addition 300 coolies carrying commissariat supplies. On the 11th, Colonel Macpherson started with the advance, consisting of 150 Goorkhas, and bivouacked that night at a distance of 12 miles. No Howlongs had been seen, but a white flag had been found suspended at the point where the River Dulesseree was crossed, and further on the figure of a man, made with sticks and leaves, with both arms stretched out, as an intimation that we were to advance no further. Colonel Macpherson had halted within a couple of miles of two villages, and when the inhabitants saw his bivouac fires they set alight to their houses and fled. The following day the General with the rest of the troops and the provision-coolies marched out and joined Colonel Macpherson. It took the coolies eleven hours to accomplish this march of 12 miles, which was one of great toil and difficulty; in fact so much so, that it could not be maintained as a permanent

stage. On the 13th a reconnoitring party proceeded to the front, and on this occasion was fortunately accompanied by the Political Officer. At first the path led across open downs covered with coarse grass, where several gayal were feeding. This was the first pasture and open ground we had seen in the country; the appearance of the forests which we afterwards entered, differed much from those we had so far been accustomed to, bamboos were exceedingly rare, and there was comparatively but little underwood. After an advance of about three miles, some Howlongs were observed to be shouting from a hill top, and it was learnt through our interpreters that they wished to open communications. Captain Lewin the Political Officer proceeded to meet them, and was then assured that the inhabitants of all the neighbouring villages wished to submit, but that the Chiefs had fled. Several of them returned to camp with Captain Lewin, and in the afternoon a considerable number of Howlongs arrived with fowls, eggs, and other articles for barter. The whole of the coolies, numbering some 450 men, were sent back this day to Sylhoo Savoonga's for supplies.

On the 14th our camp was moved to an excellent position three miles to the front; a stockade was commenced and comfortable sheds built for troops and coolies. This place was called Changmamma, and the 15 miles separating it from Sylhoo Savoonga were divided into two coolie stages. It was here that the General had determined to establish the most advanced post from which to operate in three different directions; but before any advance could be made, the return of the coolies sent back for supplies had to be awaited. The following day reconnoitring detachments were sent out in two different directions. The one which proceeded to the east towards Benkoya's village, found a considerable force of armed men on the opposite bank of a small river about two miles from camp. The chief amongst them, who described himself as Benkoya's head man, said that a small party of some half dozen might proceed and examine the country to the front if they liked, but that as Benkoya was himself coming in to make submission, if he met a large armed party he would probably become alarmed and turn back. The detachment therefore halted, and sent back to camp for orders. As the General wished to give the Howlongs every encouragement to come in, he directed the detachment to return, and Captain Lewin satisfied himself after an interview with Benkoya's people, that the Chief and his tribe were anxious to submit and come to terms, but he warned them that they must do so without delay.

On the 17th, Benkoya and Sangboonga, the two principal Chiefs, came in and accepted the terms offered by the General, and their submission was at once followed by that of the remaining Chiefs of the Northern Howlongs. The negotiations were conducted by Captain Lewin, and there can be no doubt but that many small difficulties which arose were smoothed away by the wonderful personal influence which that Officer exercised over these rude barbarians. The Chiefs had a great fear of treachery, and it was no easy matter to disabuse their minds of the idea, that if they came to an interview in the neighbourhood of our camp, they would not be seized and either transported or beheaded. They brought forward the story of the Northern

Lushaie Chief, named Lal Chokla, who some years ago surrendered himself, as they say on a promise of pardon, but was then seized by us and transported. And it is so far true that such a Chief was transported, but it is not to be supposed that any British Officer had previously given a promise of pardon. These Chiefs brought in some captives with them, and others were sent in, in the course of a few days, and from their evidence the General was able to satisfy himself that none of them had been kept back.

On the 16th, sufficient supplies had been collected at Changmamma for 1,000 men for twelve days, and before these had been consumed, fresh stores could have been forwarded from the rear. Had the Northern Howlongs declined to come to terms, there can be no doubt but that all their large and important villages, and the greater part of their grain stores could have been destroyed within the space of twelve days. Changmamma is 210 miles by the line of advance followed, from the base of the column at Chittagong, and 85 miles from the advanced depôt at Demagree. A detachment subsequently proceeded to Benkoya's village, about 15 miles further on, and situated on the eastern border of the Howlong country, which was the most distant point in this direction reached by the troops of the column, and may be stated at 225 miles from the base. Had it been necessary, the General was in a position to have advanced by rapid marches 50 miles beyond Changmamma. It must be borne in mind that the length of the direct line of advance cannot be taken as any test of the extent of country traversed. It may be said that almost every corner of the Syloo country was looked into; wherever an encampment was discovered a detachment was sent out to destroy it; villages in every direction and at several days' march from the main line of advance were attacked and burnt, and all storehouses at whatever distances perceived, were doomed to destruction by the Goorkhas. The Syloos, having of their own free will resolved to fight, and having rejected our subsequent overtures to come to terms, drew down on themselves certainly a severe punishment, but one which the General hoped would have a lasting effect both on themselves and on the neighbouring tribes. And there can be no doubt but that it had an immediate effect on the Howlongs. They had watched from their hill tops, for two months, the steady burning of one Syloo village after another, and had been told by fugitive and famished Chiefs of the dreadful effects of our steel guns and Enfield rifles.

It will be remembered that according to the original instructions issued, the two columns were eventually to meet. The line of advance followed by General Bourchier had been so far to the eastward of what had been expected, that a meeting with the Cachar column would have been attended with more fatigue and risk than the result could warrant. General Bourchier's advance had been most successful, but in order to reach the most guilty Chief on the Cachar side, it had been necessary to make a march of very great length. He had reached Lalbourah's village of Chumphai on the 20th February, on which date he had sent up rockets, hoping they would have been answered from our column; but the high intervening mountain ranges, and the distance he was

from us as the crow flies a good 50 miles, had prevented their being seen. As General Bourchier retired at once after burning Chumphai, and taking into consideration the great distance he there was from his base, it is hardly possible that he could have remained stationary for even a couple of days, much less have advanced to meet us. For the two columns to have met, it would therefore have been necessary for a detachment of General Brownlow's troops to have marched at least 80 miles over an unknown and mountainous country, and to have made its way through several independent tribes, who would in all probability, have resisted its advance. In the face of these difficulties, and more especially on account of the enfeebled state of both troops and coolies, the General decided against attempting to effect a junction with the other column.

After peace with the Howlongs had been declared, our camp used daily to swarm with hundreds of these people, with whom a very brisk business was done. The only articles of food they had for sale were fowls and eggs, but numbers of their pipes, sporans, powder-flasks, sheets, &c., were bought as curiosities. We found them a good-natured, active, manly race, very independent in their manners, and very curious about all matters connected with us. Colonel Macdonald, of the Survey, who was the tallest man in our camp, generally had a group of admirers round him during the greater part of the day, and we all had to allow them occasionally to satisfy themselves by looking up our sleeves that the rest of our bodies was of the same colour as our hands and faces. These people were the most inveterate smokers it is possible to conceive, and their little children are seen to go about, pipe in mouth, as soon as they can walk. They proved altogether of great interest, and I regret that the limited length of this lecture prevents my saying more about them.

Two detachments were sent out some 15 miles in different directions, with the Survey Officers, and leaving Colonel Macpherson with the head-quarters of his regiment to await their return, the General with the rest of the troops, marched on the 23rd to Sylhoo Savoonga. On arrival at that place, it was ascertained through the Howlongs, that the principal Syloo Chiefs had assembled near the site of Lal Jeeka's village, and that there was a division in their councils as to what course they should pursue. Some were for waiting until we commenced to retire, and then attacking us in a combined body, whilst others wished to give in and accept the General's terms. This intelligence caused General Brownlow so far to alter his plans that, instead of hurrying on to proceed against the Southern Howlongs, he determined to wait Colonel Macpherson's return, and then try to strike another severe blow at the Syloos before the season compelled him to vacate their country. However, on the afternoon of the 25th, some Syloo emissaries arrived, and were anxious to know how their Chiefs would be received should they come in; and early on the 27th, the seven principal Chiefs of the tribe appeared, bringing with them offerings of gayal, goats, gongs, elephants' tusks, &c. They most solemnly declared that they had only a few captives left, and that it would take some days to find these. The head-quarters of 2nd Goorkhas had

reached Sylhoo Savoonga on the 26th, and on the following day, as soon as peace had been concluded with the Syloos, a detachment was sent to the rear, and orders were dispatched for the 27th Punjab Infantry to retire on Demagree as their several posts were relieved by the 2nd Goorkhas. The latter regiment was to occupy posts on the Rhae Jan Klang range, on account of the salubrity of the position, until required to start to Chittagong for embarkation. On the 28th, a survey party, with a small escort, and with thirteen days' supplies arranged for, started to connect the survey operations of the column, with those that had been previously made, as far as Byparee Bazaar.

Leaving Colonel Macpherson to retire gradually, as the stores which had been collected at the several posts were cleared out, the General started with brigade head-quarters on the 29th, and proceeded by double marches to Demagree, which he reached on the 4th March. On arriving at that place he found the Southern Howlong Chiefs had sent in a certain number of captives, but it was believed that they retained some in their possession, and moreover they had not come in to make personal submission to the General, as they had promised to do. He therefore determined to proceed into their country with a detachment composed of 27th Punjab Infantry and 4th Goorkhas, which regiments had not undergone such hard work as the 2nd Goorkhas, and as no serious resistance was anticipated, the remainder of the troops and those coolies not required were to be pushed down to Chittagong and embarked, as transports were provided for them from Calcutta. Accordingly the General started on the 7th March, with one mountain gun, two companies 4th Ghoorkhas, and two companies 27th Punjab Infantry. With this force he marched over 40 miles in three days, across a most difficult country, to the village of the chief Sypooea, situated at an elevation of 4,100 feet above the sea. This Chief went out to meet the General, and at once did all that was required of him. On the 10th and 11th the force halted, but as some Chiefs still did not come in, another march was made on the 12th, which resulted in bringing in all the heads of the Southern tribe, whose submission was required. Several more captives were surrendered, and from this part of the tribe alone nearly 100 British subjects were recovered. Some of them had been in captivity for years, and as a rule, they seemed very far from rejoiced at their deliverance. On the 14th and 15th the General halted, in order to allow of the survey parties proceeding out in different directions, and on the 16th he commenced moving back to Demagree. The vigour and rapidity with which this advance into the Southern Howlong country was made, received the most marked praise and approbation of the Commander-in-Chief.

The operations of the column were now closed, and I will borrow from the General's despatch to describe briefly the results of the four months' campaign. They were "the complete subjection of two powerful tribes, inhabiting upwards of sixty villages, of which twenty that resisted were attacked and destroyed; the personal submission of fifteen chiefs, and their solemn engagement on behalf of themselves and tributaries for future good behaviour; the recovery of Mary Winchester, and the liberation of upwards of 150 British subjects,

"who had from time to time been made captives. In addition the "operations of the column, which by frequent departures from the main "line of advance, covered a large area, enabled the Officers of the "Survey to triangulate 3,000 square miles of country, more than half "of which was surveyed in detail, and also to complete the connection "between the Cachar and Chittagong districts."

Our casualties were trifling and consisted of 7 killed and 13 wounded; from sickness, there were 30 deaths amongst the fighting men, and amongst the coolies and followers, 118. There is one matter on which I think Sir Charles Brownlow may justly pride himself, and that is, that despite the constant endeavours of the Syloos, we did not lose one coolie or camp follower, and this can only be attributed to the very complete and strictly enforced orders which the General issued about escorts, and against wandering at any distance from the posts occupied.

The same day that the General returned to Demagree, he dispatched the artillery and detachment of 4th Goorkhas down the river. Arrangements had been made for the return of all troops and coolies by the Kurnafoolie, so that the march through the unhealthy country lying between Demagree and Burkul might be avoided. The weather was getting very hot, and as at this season cholera was to be expected, very careful arrangements for the movement of troops and coolies to Chittagong had to be made, so as to avoid overcrowding at any one post, and so as to retain detachments in occupation of the most healthy positions until the latest possible moment.

On the 17th March the head-quarters 4th Goorkhas embarked at Chittagong, and vessels continued to take detachments thence every fourth or fifth day, until the 1st April, when the brigade head-quarters and the last of the troops embarked, and reached Calcutta on the afternoon of the 3rd.

I feel extremely doubtful if it is becoming in me to make any remarks regarding the General, on whose staff I had the honour of serving during this expedition. But I trust he will not take it amiss, if I mention that it was the opinion of those who served under him, that the success he obtained was in no small measure due to the confidence in his ability and experience, with which he inspired all under his command. The necessarily limited length of this lecture has prevented my entering on many important particulars connected with the operations of the Chittagong column, and the account I have given will lead probably to the conclusion, that the whole business was very easily and smoothly conducted from beginning to end. But I must observe that many difficult and delicate questions arose, and if these had not been met with that decision and ready assumption of responsibility, which are so characteristic of Sir Charles Brownlow, the small campaign on which we were engaged might have had a very different termination from that which actually occurred. To be perfectly successful in Indian warfare an advance must be steadily continued until the desired results have been attained. Any semblance of retreat, or a lengthened delay at any one point, embolden an Indian enemy, and he may then become very enterprising in his attacks and difficult thoroughly to subdue. General

Brownlow's advance into the Syloo country was not rapid, but it was sure and steady, and it was conducted on the principle that had it been necessary to halt for any lengthened time to negotiate, or for any other purpose, there would always be sufficient supplies available to prevent the necessity of having to retire before the work to be done, had been satisfactorily settled.

In all previous expeditions against the Lushaies, our troops had simply advanced into their country, burnt a village or two, and then retired again as quickly as they had advanced. The Lushaies appear to have thought that we should have done the same on the last expedition, and most probably this is the reason that induced them to resist us.

From the experience of this expedition one general conclusion may certainly be drawn, which is, that when campaigning in a hilly country in India, tents may with safety be dispensed with. It would be difficult to find a more trying climate for the experiment than that of Lushaie, and yet I can confidently assert, that the possession of tents would in no way have improved the health of the troops. When tents are not provided, each man should have a waterproof sheet, a great coat, and a good blanket; the latter to be carried for him. The waterproof sheet should be 7 feet 6 inches by 4 feet, with eyelet holes round the edge; the weight of such a sheet is 4 lbs. It can be used on very wet ground to lie on, or should time not allow of huts being built, it can be used as a *tente d'abri*, and it can also be used as an extra covering against cold, or two men might lie on one, and cover themselves with another. In the moist, relaxing climate of Lushaie, there was no doubt regarding the beneficial effects of the issue of a moderate amount of rum, and I think it may be concluded that in the hills of India, where the native soldier on service does not always get the same amount of animal food as when occupying cantonments in the plains, and where often British troops enter on a campaign somewhat debilitated from the effects of a trying hot season, the issue of rum is not only beneficial, but absolutely necessary.

The circumstances under which hill expeditions are undertaken in India, and the nature of the country and of the climate are so various, that it would be impossible to lay down any rigid scales of organisation, equipment, or carriage, &c., which would be applicable to any case which might arise. But the experience of all expeditions should be carefully collected and arranged in a tabulated form, and such information would undoubtedly be of great use, in arranging the details of any force, that may in future be sent on active service. I believe that during the last few years, it has been the practice in the Quartermaster-General's Office in India, to compile all such information.

It is now generally acknowledged that when troops take the field, too much attention cannot be given to the proper organisation of an efficient and sufficient means of transport. The equipment, organisation, and fighting qualities of our troops, both British and native, are all that can be desired, but these become useless if an army is incapable of rapid movement, owing to insufficient means of carriage. The Officers placed in charge of the transport should be selected with the greatest care, and should be both well rewarded and well paid, so that

this particular service may not be looked down upon, as has been generally the case. As soon as an expedition is decided on, the carriage should be at once entertained and organised, and should, if possible, be in a thorough state of efficiency before the troops take the field, and it would be even advisable, to delay the commencement of operations until this result can be attained. It is a difficult and unsatisfactory process to attempt the organisation of a transport train, as it arrives piecemeal at the scene of operations, when it is necessary to put every detachment of the train to work as soon as it arrives. There can be no doubt, but that the success of hill campaigns in India must depend entirely upon the efficiency of the carriage employed. The Commissariat Department worked well, but it was under-handed, there being only three Officers to superintend a line of supply nearly 200 miles in length, and one moreover of great difficulty. The only carriage worked under the control of that Department were the elephants, and as it required the whole time and attention of one Officer to arrange proper stages, and to set these animals to work, an energetic subaltern of the artillery, Lieutenant Brough, who had had experience with an elephant battery, was detailed for a short time for this special duty.

It is only right to mention, that despite the very hard work, and the somewhat severe privations undergone, there was never a grumble heard amongst either Officers or men, and I do not think that any body of Her Majesty's troops, especially the 2nd Goorkhas, on whom the hardest work fell, ever performed a rather trying duty with greater cheerfulness than those composing the Chittagong column of the Lushaie expedition.

In conclusion I would express my humble opinion, most strongly confirmed during this short campaign, that on active service it will be absolutely necessary to amalgamate the Adjutant and Quartermaster-General's Departments, under a chief of the staff, and if this opinion, which I believe is that of many high authorities, is correct, it appears desirable that this amalgamation should be honestly and thoroughly carried out during times of peace.

APPENDIX.

	Officers.	Fighting men.	Followers.			Baggage Coolies.		
2nd Goorkhas	7	300	Company followers	15	74	Blankets, at 10	30	84
			Dooly bearers	44		Cooking pots	24	
			Hospital establishment	6		Great coats, at 32	8	
			Officers' servants	9		Native officers	4	
						Medicines	3	
						Native doctor	1	
						Officers	14	
Sappers	1	20	Company followers	3	14	Tools	13	25
			Dooly bearers	6		Flags	1	
			Hospital establishment	1		Hospital	3	
			Mistrees	3		Men's baggage	6	
			Officer's servant	1		Officers	2	
Royal Artillery	4 (Includes Dr. Meadows.)	41	Public followers	16	19	Guns	30	77
			Officers' servants	3		6 boxes ammunition	18	
						Tools and stores	3	
						Tarpaulins	1	
						Pannier and tarpaulin	2	
						Men's kits	13	
						Officers, 8; spare, 2	10	
Survey	2	0	Servants	2	12	Axe coolies	3	12
			Lascars	10		Lascar's coolies	3	
Political	1	0	Kookies	12	20	Officers' coolies	6	
			Interpreters	5		Coolies		8
			Orderlies	2				
			Servant	1				
Brigade Head Quarters	5	1	Servants	5	9	Baggage coolies		12
			Chupprasie	1				
			Syces	3				
	20	362			148			218 = 728

N.B.—Officers were ordered to take several days' rations, and for this purpose extra baggage coolies were allowed.

LECTURE.

Friday, June 21, 1872.

Colonel the Honourable P. R. BASIL FIELDING, C.B., Commanding Coldstream Guards, in the Chair.

PERSONAL EXPERIENCES AND REMINISCENCES OF THE SIEGE OF PARIS.*

By Surgeon-Major Wyatt, Coldstream Guards, F.R.C.S., Officer of the Legion of Honour and Consulting Surgeon to the National Rifle Association.

There are duties associated with every public position from the discharge and responsibilities of which, no man can venture to absolve himself, or to shrink from willingly rendering an account of his stewardship, but more especially is it due to this Institution, which evinces so deep an interest in all matters pertaining to every branch of the Naval and Military services of the country. When our indefatigable secretary wrote to inform me that the Council had done me the honour to request that I would deliver a lecture on experiences gained during the siege of Paris, I felt very considerable difficulty in undertaking the duty, although appreciating very highly the distinction implied in the request.

In accordance with the title of the subject selected, it appears incumbent on me to review the circumstances and events which occurred during my sojourn in Paris, and to submit to you a brief record of personal narrative, without allowing myself to drift into more strictly professional details than is likely to be interesting to such a distinguished audience as I have the honour to address; then, to review any special peculiarities of the siege; and consider the practical instruction afforded by its varying aspects and periods. Having had the good fortune to serve throughout the Crimean campaign, during which I was enabled to obtain much practical information of the medical department of our gallant Allies, as well as of the Russian Army, to which, after the declaration of peace, I was officially accredited on a special mission of enquiry, it was then manifest that, compared with the recorded experiences of former wars, much was capable of improvement and many principles required to be modified in accordance with the recognized laws of sanitary science especially,

* The publication of this lecture has been unavoidably postponed.—Ed.

but also in the practice of military surgery; and if such was then a fair conclusion, how much more evident must it now be, owing to recent development and discoveries in the increased destructiveness of improved weapons, combined with the altered character of military strategy and tactics. It will be in your recollection that, on the 15th July, 1870, the Duc de Gramont proclaimed, in the French Chamber, that the Emperor had resolved on war with Prussia; after which announcement, I inquired, through an official channel, if it were likely that any subject of a neutral power would be allowed to accompany the French Army, for the purpose of observation of matters connected with military surgery, but was informed that an inflexible rule had been laid down not to permit any foreigner to be associated with it, in any capacity whatever; the reason for which decision will be easily understood, when we remember how thorough a want of all preparation for war, in every department of the Army, was subsequently manifested; but, unfortunately, much valuable opportunity was lost by the delay which occurred, in persuading the authorities of both nations to sanction so desirable a mission—a thing to be regretted, both on the score of humanity and science. I shall carefully avoid alluding to political theories in this Institution, but we all must have had our personal sympathies at the commencement of the war, which, with many, no doubt, as events progressed, became modified; yet I, at least, could not forget my old Crimean friendships and associations, or the generous succour rendered by the French, to our sick and wounded, on the banks of the Alma, and their active and ready conveyance of our disabled soldiers from the inclement heights of Sebastopol to the transports in Balaclava harbour. These circumstances, coupled with the inability to speak the German language, must account for my preference for the mission to the French Armies. It is, indeed, with a self-mistrustful spirit, and specially of my own powers of expression, that I venture to claim your indulgence for the many shortcomings and imperfections in the observations I shall have the honour to offer, for I am fully convinced that the amount of experience gained will be thought of slight value compared to what might have been expected from the circumstances attending the siege of a capital possessing such resources as Paris; but I venture to hope that, acting on the determination to form an unbiased judgment, from personal observation alone, a few conclusions have been arrived at, which may tend to confirm some of our guiding rules, if not to suggest others capable of being turned hereafter to useful account, in the interests of military surgery.

By the favour of the Secretary of State for War, and with the sanction of His Royal Highness the Field-Marshal Commanding-in-Chief, I was directed to proceed to the Head-quarters of the French Army. I arrived in Paris, with the Queen's Messenger, on the 10th September, 1870; on the 18th, the investment of the capital by the German Army was effected, the girdle of iron having been effectually drawn around the whole circuit of the beleaguered city. The official instructions received were, to proceed to the Head-quarters of the Army, which was a physical impossibility, as none then existed, and as the then Minister of War, General Palikao, had been superseded by General

Le Flo, great delay arose in our recognition by the military authorities.

The circumstances of being shut up in Paris, so completely changed the character of our position, as intending observers of military operations in the field, that, for the sake of having some occupation, we requested permission to offer practical assistance in the hospitals, if the authorities were willing to avail themselves of our services, and we were subsequently provided, by the Intendant-General, with a general order of admission to all of them.

At this time the spy-mania was at its height, and my worthy Scotch colleague, who had preceded me to Paris, but who, unfortunately, was then unable to speak the language, was very soon arrested, and exposed to considerable indignity, by being carried off through the streets to the Prefecture of Police. The account of his troubles amused me, but my own powers of endurance were soon destined to be tested in what might have become a far more serious matter, which I will briefly relate.

Just before leaving England, I had received a letter, written in German character, which in the hurry of departure I accidentally put into my pocket, intending to ask some one to translate it. I had emerged with a friend from the Palais d'Industrie (at that period the seat of operations of the Société Nationale de Secours aux Blessés), and found a battalion of infantry on the line of march, halting in the Champs Elysées. We made a few passing observations to one or two of the soldiers who were decorated with our Crimean medal, and continued our route, but shortly after, a corporal with a file of men surrounded us, and to our surprise announced that his Captain had ordered that we should be arrested as spies and conveyed to the nearest military post. I suddenly recollected that the unlucky German letter was in my trowsers pocket, but the difficulty of tearing it into fragments with one hand and gradually dropping them undetected in the street, can only be appreciated by anybody who will attempt the necessary manipulation, under strict surveillance. The valiant Captain of the National Guard at the Mairie, to which we were conducted, happened to be a tradesman, who stated that he was patronised by many English customers, which was rather a cheering announcement, and he was good enough, moreover, to dispense with the formality of any personal searching, which was for me a further relief. We were then allowed to despatch a note to our Embassy, from which an Attaché soon arrived to account for us. It was a reminiscence not to be forgotten in those peculiar times, but we were informed next day that the official report against us was for having been found on the ramparts examining the cannon. At this period of the siege, to look at the name of a street or ask for the slightest information, rendered you an object of suspicion to some zealous patriot, but to be seen taking a note of anything, was fatal to your personal liberty. The correspondents of the press were very energetic in absorbing every portion of news percolating through the remaining Embassies, but the events to be recorded, even with the advantage of their graphic genius, did not offer much variety, yet they strove hard to witness as many incidents of the siege as possible, and several of them endeavoured to procure a better recognised position

by temporary employment on the staff of the ambulances, under the protection of the red cross, rendering good service in aid of the wounded, and obtaining greater facilities for accurate observation of events. The French journals were too often replete with fabulous reports. Our mission, of course, was to inquire into every variety of sanitary and surgical detail connected with military service, but it was to the latter branch that I was directed to devote my special attention. When, from the completeness of the investment, all communication with the provinces was cut off, the capital was necessarily thrown upon its own resources both as to men and material, with the necessity of providing for the accommodation of the sick and wounded. On the 5th September, General Vinoy arrived in Paris with one corps d'armée, composed of three divisions of regular infantry, with a due proportion of cavalry and artillery, and also some provincial mobile troops; after which the estimated strength and material, composing the available garrison, was stated to be about 50,000 troops of the line, 100,000 garde mobile, 300,000 national or civic guard, with 25,000 sailors and franc-tireurs, yielding a total army for the defence of Paris of 475,000 men (more or less) for the accommodation of whom, beside the regular barracks, temporary encampments were formed in every available situation, consisting either of the *tentes de troupe*, for the accommodation of twenty men, or the *tente d'abri* for two, one-half of the latter tent being carried by each man; besides this, some very light wooden huts were hastily put together, but whether the encampments were temporary or permanent, there was a lamentable deficiency of all necessary sanitary arrangements.

Almost from the date of the investment, General Trochu's efforts were directed to the welding together of this heterogeneous mass of living material, almost all the available thoroughfares being appropriated to incessant drilling, and it was interesting to watch the relative aptitude of the various squads of recruits, for Paris might then have been considered as a gigantic barrack square. I observed one little novelty which is suggestive, when a rapid instruction in manual and platoon exercise is required. A squad of recruits being formed up in line before the drill sergeant, the most inexperienced would be placed between two others more advanced in drill, so that he might not only hear the word of command given by the sergeant, and observe his practical manipulation, but also become aware of the action of his comrade on either side. This appears a useful hint worth remembering, although perhaps not quite in my department. A humorous friend called it an illustration of one raw being placed between two readys; verily the whole manhood or boyhood of every description and occupation appeared imbued with an uncontrollable military mania, for even the children in the streets had their tiny chassepôts, knapsacks, and drums, to play the game of soldiers. Considering the urgency of the moment it was impossible, as it would have been unfair, to institute any comparison between the army of defence, as then existing, with that of ordinary times, far less with such troops as we remembered in the Crimea; indeed, the greater portion of the regular troops, comprising General Vinoy's Corps d'Armée, had seen service in the field,

and, although young, were obedient to discipline, but they were not sufficiently numerous to exercise, over the masses of armed men around them, any very abiding influence of control; the discipline of the 35th Regiment of the Line was very creditable. There was a perpetual marching of regiments from one side of the city to another, according as the Council of War decided upon changes in strategical plans, and it was often remarkable with how heavy a burthen the soldier toiled on the line of march, for beside the regulation weight of 72 lbs., which is about 10 lbs. in excess of that which the British soldier carries, he was often weighted with many extras, rendering him quite independent for a time of all transport conveyance, either for food, fuel, or shelter, a great desideratum no doubt, when a cautious reconnaissance is attempted; but I cannot think the *tentes d'abri* altogether desirable for any prolonged occupation. As the cordon of investment was so close to the besieged city, the movement of troops outside the fortifications was necessarily very limited in extent. The scale of rations could not be kept uniform, and as the siege advanced, the daily allowance proportionately diminished, becoming eventually altogether insufficient to sustain even a moderate degree of physical strength, but, under every circumstance the *bouilli* always somehow appeared at the evening meal, in confirmation, I suppose, of their maxim, "that the soldier makes the soup, but the soup makes the soldier." The regulations of the French Army require that the Captain of each company should direct his special attention to the daily supply of provisions for the men, and the instructions are very rigid on that point, requiring the Officer to state in his report, that he had tasted the soup.

At the final sortie of Montretout, the whole of the food carried by each soldier, for six days' consumption, consisted of 10 sailors' biscuits, 1 lb. of sugar, 1 lb. of roasted coffee (not green), 50 grammes (or about 1½ ozs.) of salted meat. I was often reminded by the fragrant smell of their hot coffee, of our sad acquaintance with the green berry, of Crimean fame, and I recognise now, amongst my audience, a valued friend, who supplied it to the authorities, after protesting in the strongest manner against its issue in such a state.

The Garde Mobile was at this time a component part of the civil army of France; it was raised about three or four years before the war, as an auxiliary to the regular forces; but it must not be confounded with the Garde Nationale sédentaire, such as formerly existed in all the large towns of the Empire. The Mobile Guard is a kind of provincial militia, the men coming chiefly from agricultural districts; the Officers were appointed by the Minister of War, many of them having more or less of hereditary position in their departments; but the non-commissioned officers were appointed by the Chef de Bataillon. The men, on an average, were from 20 to 25 years of age, the best period of life by far for active field service, and most of them had previously drawn "bon numéros" for the conscription. No substitutes are allowed by purchase, as in the line, and they must serve for a period of five years, but on home service only, assembling for drill once a week during the summer months (generally on Sunday) at the principal canton or arrondissement of their department, where their arms and

accoutrements are kept, and for this duty they receive a regulated daily allowance upon a higher scale than the regular Army. Each battalion is composed of from 800 to 1,000 men, and when embodied, the discipline is identical with that of the line. I have alluded to the organisation of this national force, because much misconception exists as to its nature. The contingent which came to Paris did very creditable service, and I can safely say the men were generally quiet and steady: I doubt whether the same number of country militia recruits in London would have conducted themselves better, if so well. Their military career during the siege proves that a well-affected civil element can be soon welded with more experienced soldiers for active service. The forts were all garrisoned by sailors, who were vigilant, courageous, and obedient to discipline; indeed, it was difficult for their Officers to induce them to surrender their positions to the Germans, in accordance with the terms of the capitulation; and for many days after the evacuation of the forts, they might be seen in groups wandering about the streets of Paris, with a downcast look of melancholy dissatisfaction; they were, however, decidedly in better physical condition than the soldiers, whose privations and exposures throughout the siege had been so much greater. The Franc-Tireurs were a set of marauding volunteer sharp-shooters, amenable to scarcely any control; they harassed the outposts of the enemy, but scarcely deserved to be considered as legitimate combatants, taking great credit for the successful stalking of any unfortunate German sentry or vidette whom they might catch unawares. As to the so-called National Guard, with which every town in France abounded, I fear the contingent of Paris cannot as a body be spoken of very favourably, but as it has now been disarmed and disbanded, I have less hesitation in stating my own impressions. Every elector became *de facto* a member, and the code of regulations to which they are subject is peculiar, but very extensive, occupying a large volume, which I had some difficulty in procuring for presentation to our War Office. It contains instructions upon the minutest point of organisation and discipline, but the events of the siege furnished a signal example of how a theoretical discipline will break down in practice. The rank and file varied between 25 and 45 years of age; they perform periodically military service through the year, generally about once a week; residing at their homes, and retaining their arms, accoutrements, and clothing. If they do not appear for duty after being warned three times, they are liable to be imprisoned for any period not exceeding five days; but after a certain number of these periods of absence, they forfeit entirely their civil rights, by order of a "Conseil de Discipline." During the siege, the daily pay of a private was 1½ francs, with 25 centimes for his wife; they were also entitled to receive succour in kind from the municipal store. Their sphere of duty during the siege was chiefly upon the fortifications and interior of the city; the officers are all elected by the men, but the *chefs de bataillon* are chosen by the officers, in whose deliberations five men per company take part; each battalion numbers 1,500 rank and file.

During the exigencies of the siege, every Commanding Officer was

vested with authority to deprive any man of his daily pay, but upon continued absence, after being warned three times for duty, he could award forty-eight hours' confinement. There was a General Officer Commanding-in-Chief, with a Brigade-Major, the former paid by the Government: being quite a family party, the National Guard have a *conseil de famille*, to administer and regulate the internal affairs of each company, such *conseil* being composed of the Officers belonging to it, one selected non-commissioned Officer, and two privates.

Towards the latter part of the siege, an effort was made to associate a portion of them with the Army outside the fortifications; four special companies, of 125 men each, were selected from each battalion, and, with a similar contingent from other corps, a battalion of Garde Mobile de Marche was formed of 1,000 men, who selected their Officers in accordance with their usual custom. At first, it was decided that marriage should exclude service in this special corps, but that idea was subsequently abandoned, and if there was no family to provide for, no exemption was permitted. They were all furnished with new uniforms. The career of the National Guards requires some further notice, inasmuch as their name must be for ever identified with this memorable siege; and I am the more anxious to do so, because a distinction must always be made between the battalions belonging to the well-affected quarters of Paris, called the party of order, and those raised in Belville and Villette, the habitation of the most dangerous characters of the population, who, when enrolled and armed as citizen-soldiers, were subsequently guilty of the most atrocious deeds of cruelty and despotism; indeed, it was marvellous that so insubordinate and lawless a community could have been so long capable of tolerating, much less submitting to, any constituted authority; possibly the chiefs of the "rouge" party were biding their time, and waiting for a favourable opportunity for the development of their plans, which the disarming of the regular Army, at the instigation of M. Jules Favre, at the time of the capitulation, unfortunately provided. These misguided battalions hoped, no doubt, to have found more sympathy and adherents amongst the citizens generally, in which expectation they were much disappointed; but, strange to say, the battalions of order, as they styled themselves, although ten-fold more numerous, never made any real attempt to stamp out the insubordinate spirit of the disaffected, who rallied to the cry of "Vive la Commune" and its symbolical representation, the *drapeau rouge*; so, for a time, they became masters of the situation, and the real dictators of Paris, establishing an arbitrary and tyrannical authority, which was oppressive to every grade of their fellow-citizens, many of whom they coerced to join their ranks. Every civilian force, to be reliable in time of war, must submit to strict military discipline, which should be the more rigid in proportion to the youth of the men and length of service contemplated; but when every man may do what is right in his own eyes, and submit to just as little control from his superior Officers as happens to be suited to his own views, all hope of true discipline must end; and when a national Army is saturated with the contagious sentiment of liberty and equality, it will invariably be impatient of control by the constituted authorities. The National

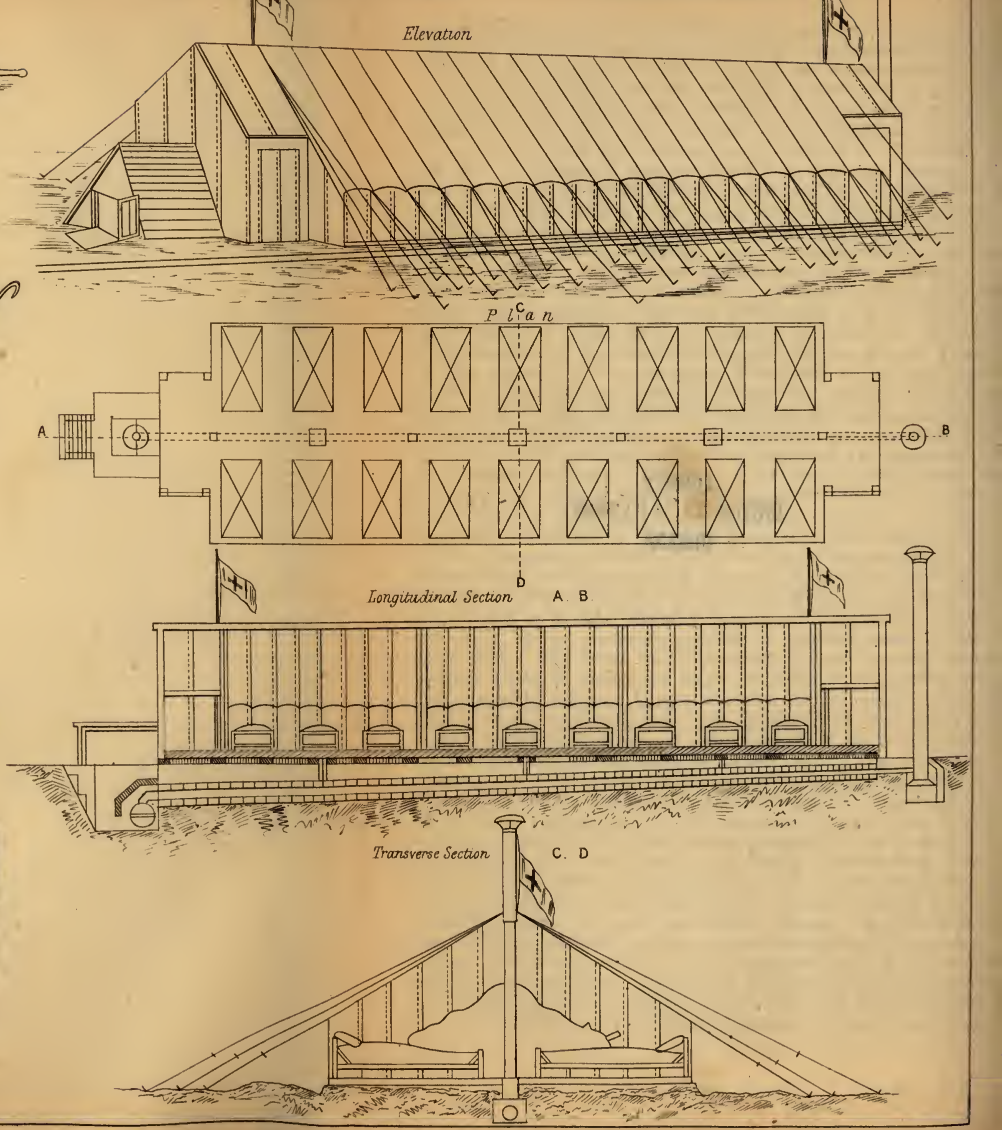
Guards of Paris were theoretically prodigious warriors, "full of strange "oaths, and bearded like the pard, jealous in honour, sudden and "quick in quarrel, seeking the bubble reputation even to the cannon's "mouth," and when comfortably seated at the restaurants, often talked loudly of their eagerness to meet the enemy, though I doubt if the interview would have been very prolonged. You may see, lying on the table, a peculiar-looking article, which is, in reality, an emblem of their prowess ; it is a life-preserver, in the shape of a steel cuirass, lined with leather, to be worn under the uniform, in front of the chest. Hundreds of these were sold in the shops, under the name of *Plastrons* or Cuirasses *Gauloises*. This protector was actually worn by a brave man at Montretout, and you see that it displays evidence of bullet marks, whether received in action I cannot say; the owner died soon afterwards, and so it fell into my hands. I doubt if our museum contains any more remarkable appendage of modern warfare. The Versailles troops, upon the final capture of their unhappy city, were accused of indiscriminate slaughter of innocent people, and although wholesale retaliation can never be justifiable, yet some allowance must be made for the feelings of loyal troops becoming excited at the sight of so much destruction around them. The following example will illustrate the ferocity of which these bloodhounds of the Commune were capable, and which I had from a strictly reliable source:—When the Government troops entered the city, and advanced by the Arc de Triomphe to the vicinity of the Palais de l'Industrie, driving the Communists before them, a sergeant and private of Chasseurs, who got too far in advance of their detachment, were captured and taken to the Place de la Bastille, where a barricade, like a veritable fortress, had been constructed, behind which these unlucky captives were placed, and forthwith invited, with a promise of speedy promotion, to serve in the ranks of the Communist forces. This they declined. The sergeant was then made fast to a chair, with his hands and feet tied, liquid petroleum well rubbed into his hair, cap, and clothing, and the poor creature set fire to. A crowd of sentries and others gathered around, one and all deaf to his cries and entreaties for mercy, while this diabolical atrocity was being acted. His comrade, feeling assured that his turn would come next, seized a favourable moment to dart round the side of the barricade, and ran in a zig-zag direction down the street; he was fired at several times, but escaped unscathed, and eventually returned to the same house in which he had been billeted the previous night. It is only such wretches as these who could have taken part in the murders of the unoffending hostages in La Roquette, and I cannot regret that some of them subsequently received the retributive and well-deserved punishment at the hands of the Marquis de Galliffet.

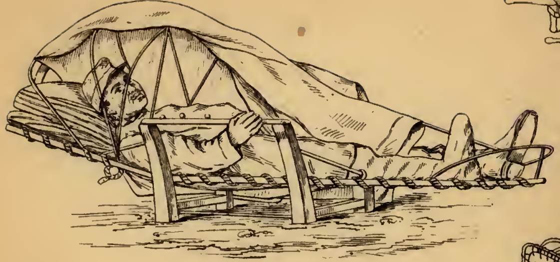
Besides the frequent encounters between the outposts, there were four considerable sorties carefully organised beforehand, three of which resulted in severely contested struggles, but all, as you are aware, invariably terminating in defeat; still each one of them presented certain peculiarities more or less instructive. The first demonstration, which might be appropriately termed a reconnaissance in force, took

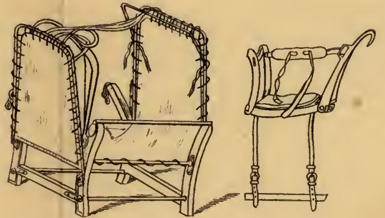
place, at noon, on the 30th October, in the direction of Reuil, and resulted in an engagement with the enemy more severe than was expected. It was evidently an effort on the part of General Trochu to test the quality of his troops, who did on this occasion carry their kits; there was great excitement in Paris that morning when it became known, the necessary orders had at last been given for the rendezvous of the ambulance vehicles, acting under the red cross flag, as it was the first occasion on which they had been combined with those of the regular Army. The arrangements made for the wounded were conducted in a satisfactory manner, under the control of the Intendance. The second sortie, on the 29th November, resulted in the battle of Champigny, in which the efficacy of the mitrailleuse was fairly tested for field service. The weather was perfect in every respect, the sky clear, the atmosphere bright and crisp, and at night a glorious moon shining out, bright and clear, between the flashes of the electric light, which shot out from the fort of Vincennes, illuminated a more ghastly battle-field than even that of Inkerman. This desperate and closely balanced engagement was fiercely contested throughout the whole of one, and part of the following day, and extended beyond Brie-sur-Marne, but it resulted in the entire defeat of the French; it was, no doubt, the turning point of the siege; and had the French been able to hold the important position they captured on the first day, a very important blow on that side of the German investment would have been struck. But it was not to be; the 25,000 Wurtembergers, several times driven back by the mitrailleuse batteries, repeatedly rallied, and, true to their inspiring cry of "immer forwarts," desperately charged, and eventually carried everything before them. The French were compelled to recross the Marne, but they fought with great vigour and determination, and, for a time, General Ducrot might have felt justified in believing that the statement of his published manifesto (probably duly reported to the enemy) might be realized, viz.:—That he would break the iron band, and never return to Paris except as a dead man or conqueror. This sortie was arranged for the day before, but the Marne was so swollen by the rains as to prevent it; on that occasion the entire ambulance-transport was paraded on both sides of the Seine, near the Trocadero, and remained in readiness to move during the entire day, but was dismissed late in the afternoon, with orders to rendezvous next morning at five. The river steamers had been requisitioned for the service of the wounded, and lay all day with their steam up, but everybody felt that a day had unfortunately been lost, and that what had been so cautiously arranged as a surprise, would now become well known to the enemy. However, on the 30th, the troops moved out of Paris by Vincennes, and crossed the Marne on admirably constructed pontoon bridges, the river steamers keeping abreast of the long line of ambulance vehicles, which, besides those of the Army and of the different aid societies, comprised every species of private and public vehicle, each one having on either side of its driver, the distinctive flag of the Geneva Convention, and the national colours of the Society to which it belonged, including our own time-honoured Union Jack, which, I must say, procured for its bearer much respect, and often special consideration. It was

calculated that with the river steamers, the mules with the cacolets and litières, of which you see a drawing (see Plate), accommodation was provided for the transport of 5,000 wounded, and it was a favourable opportunity for estimating the relative value of each kind of conveyance. The appearance of these sortie excursions formed one of the remarkable souvenirs of the siege, and reminded me somewhat of the advance of our troops from the landing in the Crimea to the Alma, with the fleet of transports moving parallel to the land forces. More than 1,000 men, with stretchers for conveying the wounded from the field, were employed, a large proportion of whom had received no previous instruction or special training for rendering assistance to wounded men, whose sufferings were, in consequence, often much aggravated. This duty was best performed by the Press Society, whose brancardiers or bearers (300 in number) belonged to a religious order, called "frères chrétiens," and who, without pay or reward, voluntarily came forward to render aid in any capacity connected with the hospital-establishments of that admirable Society; for the press in France, as in this country, is ever foremost in support of all true Christian charity. From having acted as a Member of their Council, I became aware of the energy, discipline, and concord with which everything was conducted. The society was a private aid society specially attached to the War Office, and of which the directors displayed a becoming deference to constituted authority. The French soldiers are always great adepts in thoroughly availing themselves of any surrounding resource for personal convenience, when bivouacking on active service; and this was especially observable by the rapid manner in which they would construct a temporary protection for the night, by digging a pit, if no dry ditch was near, then throwing up the earth to windward, and making a blazing fire of wood within, from the ruins of the surrounding houses; when rolled up in their blankets, they huddled themselves together for the night, having previously partaken of a savoury mess of rice and horse flesh. The latter was abundantly obtained from the numerous animals killed in action, the bones of which were speedily stripped and scraped by relays of hungry warriors, each of whom carried off a portion of often quivering flesh, with apparently as much gusto as if it were a tender rump steak. A grim skeleton of the animal was thus speedily produced, which stood out in bold relief in the moonlight, reminding one of Landseer's celebrated picture of the Dead Camel in the Desert. Of all the ambulance-vehicles, that of the Americans was by far the most complete in every respect, and displayed great fertility of inventive resource; but one great requirement for battle-field service was not fulfilled by any of them—viz., that all the stretchers should be exactly of the same size and shape, so that the wounded when once placed thereon, might not be tortured by a second removal to another, specially adapted for some particular carriage; this inconvenience arose from the different societies acting independently of each other, without the control of any central organisation; and the wounded suffered in consequence. Every kind of private and public conveyance was utilized, as previously stated, for the transport of the wounded, but the great desideratum of sufficient lightness in construction was very

AMERICAN SYSTEM OF WARMING TENTS DURING THE SIEGE OF PARIS



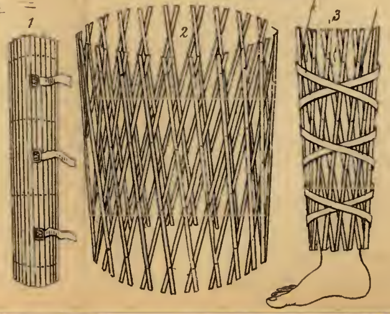




SURGICAL APPARATUS DEVISED DURING THE SIEGE OF PARIS.

An expanding Splint for immobilisation of any fractured limb for Battle field or Hospital use.

Fig. 1 The Splint contracted for portability
„ 2 Do. expanded for application
„ 3 Do. applied to the lower extremity.



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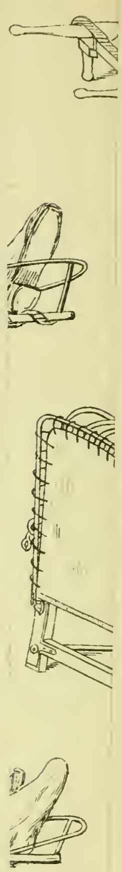

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Fig. 1
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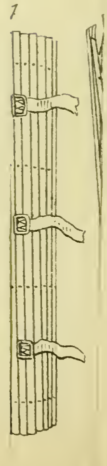


rarely attained; some of those belonging to the private society were tolerably efficient, but to provide for the conveyance of wounded men under the varied conditions and circumstances in which they may be placed, at least three kinds of transport are necessary—that by mules or horses for mountainous and hilly districts; by light two-wheeled covered carts, for employment on the battle-field, to the first lines of temporary assistance, such as a better form of the variety called massons; and four-wheeled carriages (of which those constructed by the International Society were the best) for conveying wounded from the point where they had been deposited by the previous methods specified, to the stationary or permanent hospitals in the rear. A very useful framework was contrived for supporting any kind of stretcher, upon which a wounded man could lie, in any wheeled vehicle or railway van, without being shaken. But railway transport for wounded was employed to a very small extent during the siege; indeed, the consideration of the best method for utilizing the ordinary railway carriages for conveyance of wounded, whether soldiers or civilians, is a subject not yet sufficiently developed, though deserving the earnest consideration of every Government and Railway Company. The want of water for assuaging thirst on the battle-field was also a cause of great suffering; the remedy for this is, to require every trained bearer to carry a supply in his gourd, or tin, as part of his field-kit, which should *not* be used in dressing wounds; care being taken that the transport carriages should have as large a tank as possible for that purpose. Such were some of the hints to be gathered from this important struggle, in which the French certainly fought with great bravery, but against an enemy inspired by constant previous success. The deserted houses in the vicinity might have been made more fully available for the shelter and more urgent requirements of the wounded. I must not omit to say, that the statement in the official report of Sir Hugh Rose, when acting as our Commissioner at the French head-quarters in the Crimea, was on this occasion fully borne out, viz., the inconvenience and frequency of men unnecessarily leaving the ranks to assist a wounded comrade to the rear.

The following is the statement alluded to, which deserves every consideration:—"Transport of the wounded from the field of battle to a "good ambulance, besides satisfying the rights of humanity and sus-"taining that spirit of confidence in the soldier, which, like discipline, "should never leave him, has another admirable effect:—it obviates "the incalculable disadvantage of troops engaged in action leaving "their ranks for the purpose of carrying off the wounded. Certainly, "good soldiers have no other motive in leaving their ranks for this "purpose than sympathy for a suffering comrade, but, on the other "hand, all know that on a field of battle there are at times men of a "different description, who either seek rest or refreshment, or are as "desirous of placing themselves as their companions in a place of "safety, and four or five such men are seen assisting to the rear a "man for whom one attendant would be sufficient. Nothing is so "likely to insure a reverse in action as want of confidence, and the "gaps caused by the men leaving their ranks to carry away the

"wounded, which is most practised when it is most prejudicial, at the "time and places when and where the enemy has caused the most "casualties, and consequently when every available man should be "present and ready to fill up broken lines, and assist by his concur-"rence and example in resisting or attacking the enemy."

The remedy for this would be the organisation of a *special corps of trained bearers*, such as exists in the German Army, and in the official report which I have had the honour to submit to the War Office, I proposed that two men per company should be always kept efficiently trained, who, besides being alternately employed in the hospitals during peace, would, in war time, unite to form a corps of highly trained field assistants. The first consideration with every Commander-in-Chief, is undoubtedly to conquer the national enemy, and attention to the wounded can unhappily be only secondary to this obligation, to which the medical, in common with other departments of the Army, must be subservient.

The engagements of Drancey and Bourget were fought on the 21st of December, being renewed to some extent on the 22nd. The cold was intense, the thermometer indicating 19·7° of Fahrenheit at noon, with a biting east wind; the entire plateau d'Arvon was literally swept by the German artillery fire, which, although incessant through the whole of the first day, yet caused but a comparatively small number of casualties, and as it was not possible to be too much *en évidence*, I posted myself in one of the naval batteries, and had the satisfaction of watching some well-directed practice on the enemy's position. Railway transport was here made use of for the conveyance of the sick from the station of Noisy-le-Sec, on the Strasburg line. The arrangement was simple, consisting merely of the suspension of a double row of stretchers through loops of rope attached to iron hoops driven into the transverse sections of the roof of the fourgons, after the fashion of slinging hammocks. This sortie certainly tested the quality of the soldiers, who were compelled to lie on the ground for two and three nights, badly clad and now insufficiently fed; to perform this duty with cheerfulness under such a degree of cold, entitled them to admiration and compassion, for they had not even the stimulus of victory to sustain them, but were beginning to be disheartened by a want of confidence in their leaders. The appearance of some of the sentries was grotesque enough, with the hood of their great coats enveloping their heads, in addition to a large sheepskin covering. They were generally well supplied with gloves, and were able to maintain circulation in their legs and arms by slinging their chassepôts across their back (*à la bandoulière*), which, in my opinion, is a convenient and desirable plan in cold weather, and it impedes neither efficiency or vigilance. Cold is a tonic or a debilitating agent, according to the state of the constitutional powers, but I fear the troops indulged too freely in raw spirits, which undoubtedly increased the liability to frost bite, of which there were 640 cases reported in General Ducrot's corps alone, 60 of which terminated fatally.

The fourth and last great attempt to break through the German lines was made on the 19th January. It was the first occasion

on which the bataillons de marche of the National Guard were employed with the regular troops, and they behaved as well as might have been expected. The rain which had fallen in the night and early part of the day rendered it very difficult for field artillery or infantry to move, the ground being converted into a perfect quagmire; but all evidently looked on it as a supreme effort, and although fighting against hope, and even with a foregone conclusion of defeat, many signal instances of courage and self-devotion were displayed. The Private Aid Societies, having profited by previous experience, established intermediate temporary hospitals in the villages of Luresne and Putaux, where every requirement recommended by experience, was carefully prepared; the mortally stricken were left to die in peace in these temporary ambulances, while the less severely wounded were conveyed as speedily as possible to the permanent hospitals in Paris. The system of attaching tickets to the coat of a wounded man, describing the injury, and relief afforded on the battle-field, proved of great service in preventing unnecessary subsequent interference until arriving at the permanent destination. But the necessity of special knowledge being required by those engaged in the assistance of the wounded, was here painfully manifest. In connection with this battle, an incident occurred to myself and a distinguished Austrian surgeon on the following day, which is perhaps worth alluding to. We found in one of the houses, which had been temporarily appropriated for the wounded, what the man in charge called a dead Mobile, who was lying strapped to the stretcher on which he had been brought from the field on the evening before. He was said to have been wounded in the head, which I found at a glance to be correct, but he was not quite dead, or even dying. It was an instance of which during my career I have seen several, where in wounds of the superficial parts of the brain, vitality continues and will continue at a very low ebb, often for five or six days, the respiration being scarcely perceptible. The astonishment of the concierge was great when we insisted on having the poor creature undressed and placed in a bed; but more so when he was found to be able to swallow some wine and to grasp our hand, while uttering indistinct murmurs. After remaining some time with him, we requested an interview with the village surgeon, who had previously seen him. I never was able to ascertain what became of this poor Mobile; no doubt he ultimately died, but still it was a satisfaction to have prevented the possibility of the living being buried with the dead.

The return of the defeated army to the city was marked by sad depression, visibly displayed both on the part of the troops and the crowds of citizens who awaited us at the gates, for everybody felt now convinced that the last card had been played, and that all chance of relief from the provinces must be abandoned. We could no longer delude ourselves with the hope of any relieving army from the provinces to raise the siege; moreover every sort of food was becoming daily scarcer and scarcer; a list of current prices prevailing about this period is appended (see Appendix), and here is a sample of the bread issued in daily allowances of 300 grammes, or

about ½ lb., but I will spare you the sight of the 30 grammes of horseflesh which accompanied it, and represented the amount of food supplied to each person. The composition of the bread was of common flour one-eighth part only, added to four-eighths of a mixture of potato starch, rice, lentils, split peas, vetches, oats, and rice, ground up together, with one-eighth part of chopped straw and the husks of the grain; two-eighths of water was necessary to consolidate the nauseous mass, which was of course unleavened; and it was estimated that its nutritive power was in the proportion of about 1 to 12 of the bread ordinarily consumed by the peasants.

This, with the want of fuel, caused the most severe suffering of the population during the siege; certainly I suffered most from it, as there was no other kind to be had, and it was often difficult to swallow a portion, even when dipped in the morning cup of chocolate. Horseflesh, said to be digestible, was to me unfortunately quite the reverse, even in any form. The French are decidedly an omnivorous race, and can apparently digest any kind of animal flesh, with indifference. I had an opportunity of tasting a choice morsel from most of the animals of the Jardin d'Acclimatisation, which were sold to a speculating English butcher, who was reported to have realised considerably by the transaction. The only animals spared the merciless slaughter were the monkeys, out of respect, it was stated, for the Darwinian theory of kindred. No doubt it was under the pressure of famine and consequent misery that about this time murmurs of dissatisfaction, and a cry for the Commune, began to be echoed from the disaffected quarters (prompted by the language of some of the daily journals), which culminated in the murder of the lamented General Thomas, from which date the terrible reign of the Commune may be said to have commenced.

No relative information has been yet obtained to enable us to estimate with accuracy the relative disabling effects resulting from the improved weapons of modern warfare compared with those previously employed, for although a larger number of casualties may occur in a given time, yet the aggregate loss in killed does not appear to have increased, as the above table (see Appendix) will illustrate. It used to be a common saying, that "every bullet has its billet," which might have applied to our old friend "Brown Bess," with a range of 100 yards. Of the cannon of position employed during the siege, some were rifled and some smooth-bored, with mortars, and howitzers of brass and iron. The infantry were nearly all armed with the chassepôt, which projects its bullet to a distance of 1,500 or even 2,000 yards, and it is stated that a man can fire about six rounds of ball-cartridge from it per minute, but that this rapidity of firing is effected at the expense of precision, especially with young soldiers during the excitement of action, so that though the immediate results were not so decisive as we might have expected, still the development of the long range weapons of precision has enhanced the importance of skilful tactics and strategy. The Prussian needle-gun is remarkable for accuracy of fire; the invariable defeat of the French cannot, therefore, be attributed to the comparative inferiority of their weapons. Opinions varied very much

as to the value of the mitrailleuse; but the Germans, who had the best means of judging, held it to be better adapted for the defence of positions than for active service in the field; and that the continuous growling report of the "bullet-squirt," as they called it, was more intimidating than destructive, as, even at a moderate range, it was not capable of much precision, although at nearer ranges, and brought to bear upon large masses of attacking troops, it often produced great slaughter, as at Champigny and at Gravelotte, where, in storming the formidable position of St. Privat, 6,000 men are stated to have fallen in less than half an hour, from the combined fire of mitrailleuse and chassepôts. The leaden casing of the German rifled shells rendered them most destructive, fragments being projected during their transit, and, prior to their explosion, in all directions producing the most terrific wounds; but I believe our own Shrapnell shell would be more destructive than any of the large projectiles of either the Germans or French for purposes of offence; and that it would silence the fire of the mitrailleuse, whether behind earthworks or barricades. Profiting by dearly bought experience, the Versailles troops, when afterwards attacking the Communist batteries, did not expose themselves much, but destroyed the barricades by artillery fire, and thus cleared the streets of all solid obstacles. Bayonet or sword wounds were rarely observed, very few instances of close conflict having taken place. A projectile impinging on a resisting body produces effects dependent, on the one hand, on its velocity of transit; and, on the other, on the compact structure of the bones and intervening tissues. Unhappily, in modern warfare, relief to the wounded cannot be afforded on the field of battle, with a rapidity proportioned to the extent and velocity of the destructive power employed, and modern tactical operations must, by their very rapidity, tend to do away with the separate regimental hospital system, even if it be retained in time of peace; but the duty of the military surgeon is to take care that, though the ingenuity of men may invent new means of destruction, humanity and skill be not defective in devising additional methods for the relief of suffering. Pardon me for alluding to a few professional details, just to state, that there were some peculiarities observed in the nature of the wounds which may be interesting even to you; the extraordinary deformity of the bullets, when extracted, was remarkable, even when the bones had not been much injured. Another peculiarity was, that when the bones were struck, and the limb penetrated, there was almost invariably detected a quantity of leaden scales deeply imbedded in the surrounding muscular tissues, such as at Wimbledon we call "splashings." These foreign bodies are liable to produce irritation, and the subsequent formation of abscesses, which impedes the healing of an amputated limb, or the cure of one which has been attempted to be saved by what is termed conservatism, which, in surgery as in politics, is essentially preservative. Hence my contrivance of a set of small instruments made in Paris (see Figs. in Appendix) for the detection and removal of such foreign bodies, and which effectually obviates the objection to the deservedly far-famed Nelaton probe, the porcelain bulb of which is liable to become smeared over with blood in being with-

drawn from any dry wound, and thus obscures the mark of lead upon its surface. I have, with the approbation of my generous and distinguished friend M. Nelaton, devised a sheath for the probe, which completely encases it, and is depicted in the Appendix; the same sheath also serves equally for the introduction of a gimblet to be used instead of any distending forceps for extraction of the detected lead, or for the subsequent introduction of a magnetic probe in case the foreign body should be of iron or steel, when a pair of specially-contrived forceps can be inserted through the same sheath to extract any fragments which exist. Of all special peculiarities in wounds that came under my notice, the increased severity of injury to the bones was undoubtedly the most remarkable, the comminution and concussion being extreme in every direction, especially in the course of the medullary or central canal, necessitating the most careful manipulation, and anxious reflection as regards the practice to be pursued; because, if amputation be decided on, there will often be no healing of the wound if performed too near the seat of injury, whereas, if preservation of the limb be attempted, unless the most perfect immobility can be obtained, the *dernier ressort*, or amputation, must be performed under more unfavourable circumstances than at first. Very gentle efforts in the extraction of bullets are more than ever necessary, so as to disturb as little as possible the fragments of splintered bone, or additional injury to the surrounding sensitive soft structures.

I purposely refrain from displaying any specimen of these facts, as being scarcely an appropriate place for such demonstrations.

After one decisive examination of the wound, subsequent interference is now more than ever deleterious. To aid the precautions alluded to, I devised the simple appliance (see Plate), of an expanding splint, by which any fractured limb of the body can be either temporarily or permanently secured, combining the advantage of readily inspecting the seat of injury with the application of local remedies, the cost of which is only a few shillings, and I think it an improvement on the ordinary splints used for the treatment of fractures, being of lighter construction, more portable, and far less expensive.

Few drugs are necessary in the practice of military surgery: those really essential might almost be counted on the fingers; for successful practice is now considered to depend more upon the correctness of aim (or diagnosis) than in the amount of ammunition (or drugs) consumed in the exact adaptation of means to the end; in the surgeon's self-reliance and correct appreciation of the exhaustless resources of nature, which permits him calmly to wait and abstain from doing possible harm, when he has not a reasonable hope of achieving positive good; but conservative surgery should regard the preservation of life as well as of limb, as when simply expectant or attempted without the association of accurate judgment, resulting from experience, it may lapse into that of inaction.

The German soldier, in time of war, always wears round his neck a small tin badge, upon which is stamped his number and everything necessary for his regimental identification, a regulation of vast assistance to the authorities, for the collection of authentic returns of deaths.

Such a plan would have been of great service to us during the confusion of the Crimean war. But as the German tablet is not very convenient to wear, I have devised one made of bone, on which may be inserted the necessary regimental data upon one side, with the record of native locality on the other.

The accommodation provided by the established military and civil hospitals of Paris would have been utterly insufficient for the reception of sick and wounded, if they had not been supplemented by private auxiliary assistance, which was associated, in different degrees, with the principal societies of volunteer aid, namely, the *Société de Secours* (or International), that of the press, municipal and evangelical establishments, and the ambulances constructed by some of the railway companies at their termini, all, however, being protected by the red-cross flag. But, besides this extensive accommodation, some of the owners of private houses generously converted one of their principal rooms into a *salle des malades*, in which three or four wounded were tenderly nursed and cared for by them; unfurnished rooms were supplied by others; while a third set offered apartments, with suitable furniture, but without provisions; all, however, were actuated by the same patriotic devotion, and attached their little establishments to one or other of the sections of voluntary aid previously specified. On the 25th January, the official sick report of the Army of Paris numbered 40,120 sick and 4,282 wounded, more than half of whom were housed, fed, and nursed by the resources of private charity. The International Society alone supported, in different degrees, 223 private ambulances, which represented a total of 4,450 beds, varying from 6 to 250 for each; but the selection of both its central establishments proved, as might have been expected, very unfortunate, but especially so as regards the Grand Hotel, which acquired the unenviable epithet of *le grand tombeau*, as it assuredly was to many who had the misfortune to be treated in its crowded diminutive rooms, with very defective hygienic arrangements; indeed, its continued occupation would have quite justified official suppression by the authorities, if any proper vigour had existed. Of thirty German prisoners placed on the same floor, none being very severely wounded, only eight recovered! It was under the control of an able and zealous retired Medical Officer of the Army, and M. Nelaton who exercised the surgical surveillance with his usual consummate ability; yet no other hospital in Paris proved so truly that disregard of the beneficent laws of nature will successfully defeat the best directed human skill, and that nothing can compensate for an impure atmosphere; indeed, with few exceptions, I regret to say that this observation would apply to all the permanent hospitals of Paris, in which primary union of amputations were never even attempted. The rate of mortality increased greatly with the advance of the siege, and compared unfavourably with similar months of the previous years, as the following carefully compiled table demonstrates:

A COMPARISON OF THE MORTALITY IN PARIS SIX MONTHS, OF TWO SIMILAR PERIODS.

	Three months of 1869 and 1870.	Three months of 1870 and 1871.
Small-pox	947	7,092
Scarlatina	269	217
Measles	179	526
Typhoid fever	561	4,557
Scurvy	—	—
Erysipelas	175	255
Bronchitis	1,650	6,785
Pneumonia	2,081	5,397
Diarrhœa	248	2,741
Dysentery	53	992
Cholera	15	45
Angina	140	263
Croup	278	312
Puerperal affections	182	266
Total	6,770	29,450

Few opportunities occurred for observing any of the ingenious resources of field surgical treatment, as the wounded were speedily conveyed to Paris, where, it might have been fairly assumed, that they would be placed under more favourable circumstances than can ordinarily occur to troops on active service. But I fear that if any reliable statistics are ever produced, the death-rate will be found to have been very high, far in excess of that from the often ill provided provincial hospitals, even when superintended by less experienced surgeons, but where the surrounding air and ventilation were purer than could possibly prevail in a densely crowded city like Paris, where operations, even in ordinary times, are very unsuccessful, both in public and private practice. There was a great deficiency of operative surgeons, many of the physicians voluntarily undertaking such duty who had never previously so officiated. But it is very gratifying to be able to refer to the following statistical record, which I copied from the demonstrations of a lecture, delivered by an eminent French Professor during the siege, and which is, I consider, rather a triumph for British military surgery:—

A COMPARISON OF THE RESULTS OF OPERATIONS IN THREE PRINCIPAL ARMIES.

	American.	British.	French.
	Deaths.	Deaths.	Deaths.
Disarticulation at the shoulder joint	33·3	39·2	61·7
Amputation of the arm	24·5	21·2	55·5
Do. of the forearm	5·0	16·5	45·2
Disarticulation at the hip joint	100·0	85·7	100·0
Amputation of the thigh	64·0	64·4	91·3
Resection of the knee	57·1	55·1	91·3
Amputation of the leg	35·6	25·0	71·9
Total per centage	40·2	33·9	72·8

It was, also, satisfactory to have heard the honoured name of Paget spoken of continually, with as much esteem as it justly commands amongst his own countrymen.

The advantage of huts and tents for the treatment of wounded, in lieu of permanent buildings, was only appreciated towards the termination of the siege, chiefly from the excellent results obtained at the American ambulance, with which no other establishment could compare. It was organized and maintained by the American community of Paris, and consisted of a series of double longitudinal tents, subdivided in the interior into sections, the temperature of which, even during the coldest weather, was equally maintained by a subterranean plan of artificial warming, which was most satisfactory, and quite merits recognition. (See Plate.) This kind of hospital has one great advantage, not possessed by the system of wooden huts (unless jointed), viz.: of easy transport and capability of removal to fresh soil, whenever desirable—a most important consideration in military practice. A sketch of the different sections of this hut is appended; it was constantly visited by Officers of every department in the French Army, who approved highly of the details, but never practically adopted them. The great efficacy of picked oakum, as an admirable antiseptic application for suppurating wounds here attracted my attention, and I now employ it in my own hospital; but its merits are chiefly appreciated where bad odours exist from over-crowding; it is, besides, a mild stimulant for ordinary wounds. Our mother earth, too, besides being the best of all deodorisers, is also found to be a good application. Here is a sample of highly dried and finely powdered clay soil, which I also have employed with advantage, and which, at least, has the merit of being "dirt cheap." Of 200 admissions, most of which were for severe wounds, in the American ambulances, 20 deaths only occurred, which was a result quite startling to the ideas of French Surgery.

As to the statistical results of the siege, it is to be hoped that reliable information may some day be obtained; but it is a trite observation amongst French officials that *La statistique est l'art de se tromper au moyen des chiffres*, or, as Professor Huxley is reported to have said, "Statistics reminded him always of worsted work, because they could be worked to any pattern," which is no doubt true, when figures are manipulated too minutely. As no satisfactory system exists for the compilation of correct returns in time of war, I ventured, after much reflection, to devise a brief tabular form, for periodical use in hospitals, and I am glad to say its general adoption was approved of, both by eminent military and civil surgeons, several of whom tested its merits, and signified their approval of it to me. If such a simple document were definitely agreed upon, for universal adoption, as a distinct article of any future Geneva Convention, it would, I believe, establish an unity of action and accuracy of result for national returns from which comparative deductions, whether for military or scientific records, could with great facility be drawn. The duration of the siege was four months and twelve days, that of the bombardment, exactly one month; the losses sustained by which were 107 killed and 276 wounded; the former comprising

53 men, 23 women, and 31 children; the latter, 148 men, 92 women, and 36 children: or, a total of 383.

Frequent efforts were made during the siege to augment the funds of the different private aid societies by the organisation of musical and theatrical representations; and I must not omit to allude to one striking performance of sacred music, at the beautiful church of the Madeleine, in aid of the Press Ambulance; it was a requiem service, and happened to be on the very day on which the diplomatists at Versailles were discussing the possibility of an armistice; the music was by Cherubini, and was sublime, especially the thrilling portions of the "Dies Iræ and Resurrection." I have an intense admiration for sacred music, but never before listended to it, amidst such spirit-stirring surroundings. Call to mind the grand interior of that magnificent church, and then imagine it filled with a dense congregation of mourners, all draped in black, assembled to celebrate a memorial service, for some husband, father, or brother, of whom they had been recently bereaved. All the best vocal and instrumental artists of Paris, assisted at this mournful dirge, which, combined with the peals of the organ, produced an effect not to be described by such feeble powers as mine. The contrast seemed great on coming away, to hear the old familiar booming of cannon, blended now with the sharp rappel of the National Guard, and with the muffled drums of funeral parties.

From the date of Colonel Loyd Lindsay's arrival on the 12th October, with the munificent donation of £20,000 from the British National Aid Society, our position was much ameliorated, and many proffered facilities afforded us. A committee, of which Colonel Claremont was named president, with my colleague, self, and four Frenchmen, members, was appointed by the Minister of War for the distribution of the "Don Anglais." The result of the disbursement of the fund is appended (see Appendix), and from it you will understand the kind of articles considered necessary for sick and wounded Frenchmen, to whom many of the supplies which arrived in kind, after the armistice, were utterly unacceptable; hence one of the chief items of waste in the resources furnished from the English Society, and the necessity that some one acquainted with the tastes and habits of French soldiers should have superintended the purchase of those supplies.

You will have some idea of the unrestricted expenditure, sometimes adopted by the private aid societies of Paris, when I state that the purchase of vegetables alone for 30 wounded men at the ambulance of the Corps Législatif, cost no less than 2,500 francs, or about £100. Preserved provisions had not been sufficiently collected and stored prior to the investment; these, when prepared under efficient supervision, are valuable additions to the commissariat resources of an Army. Some of the preserved goods belonging to the stores of the American Ambulance, were part of the supplies of the war of secession; and I can vouch personally for their excellence of quality even after such a lapse of time.

I understand that a lecture has very recently been delivered here, on "The Geneva Convention of 1864, &c."* I will, therefore, only remark,

* See "Journal of the Institution," vol. xvi. page 206, *et seq.*—Ed.

that the siege of Paris hardly afforded a favourable opportunity for estimating its merits, as the sphere of operation was necessarily very limited. Many individuals undoubtedly escaped the obligations of military service, by assuming the red cross badge; but without the surveillance and discipline exercised by one central organized authority, it must always be difficult to obviate this, or other abuses connected with the institution of Volunteer Aid Societies. Their sphere of action, to be really efficient, must be absolutely subordinate to military control, thus preventing all merely independent action, or the existence of any jealous rivalry; especially on the battle field, a misfortune which I can testify by personal observation to have proved highly detrimental to the interests to the wounded. It is unreasonable to expect that any nation can maintain a sufficient number of medical officers in time of peace, for the demands of an active campaign, but its medical organization should be expansive and elastic enough to meet all requirements by enlisting the aid either of civil surgeons, as was effectually done during the Crimean war, or by the co-operation of private aid societies, as during the Franco-German War. The entire service, however, must be controlled and directed by a military president, recognised at the head-quarters of the Army. Such was the system adopted by the Germans in the appointment of Prince Pless, with the title of "Royal Commissary and Military Inspector of Volunteer Aid to the Sick and Wounded of the Army in the Field," who rejected all assistance which refused to conform to the rules which were laid down, and from his judgment and decision no appeal was permitted—a very wise and judicious arrangement. Unfortunately no such controlling power existed in Paris. Most of the societies indeed worked with zeal and energy, but without the necessary unity of action.

It has become a most serious consideration, with reference to the practical application of charitable aid from volunteer societies of neutral powers acting independently with the contending Armies, whether it does not tend to relieve the belligerent powers from the imperative obligation of providing adequately for the welfare of their own sick and wounded who must necessarily always be subject to a fearful amount of misery and suffering during the hours first succeeding a general action, when the relief and care of the wounded must be subordinate to the strategical plans of the General Commanding. The lists of casualties published after the different engagements were never held to be very reliable, nor could the percentage of losses to the troops actually engaged, be ever very accurately ascertained.

In fact the peculiar composition of the Army of Defence, rendered it very difficult to determine how many had fallen into the hands of the enemy as prisoners of war, and how many were missing from other causes, for, in fact, I may venture upon the assertion that General Trochu never possessed an army which he could rely upon, and he, without doubt, exercised a wise discretion in not endangering the defence of the city by making the sorties at an earlier date, or more frequently; although at the time he was much blamed by some of the public journals for what they were pleased to term inaction. He had a difficult task to control the restless spirit within the city, and at the

same time to maintain a successful resistance to the enemy without; nevertheless, he governed with wise and methodical discretion. He attempted in some degree to solve the problem as to how a rapidly improvised civilian element could be combined with regular troops, and how much of the regulation military exercises can be dispensed with, without compromising the discipline, necessary for even defensive operations; considerations which in my humble judgment, England, with its small standing Army, will do well to weigh carefully the importance of; and as to which the history of the defence of Paris may furnish some useful hints for guidance.

In connection with the reminiscences of the siege, allusion must be made to the organised system of balloon transport, of which latterly, a regular postal service was maintained with the outer world, but unfortunately with no return, except occasionally by pigeon despatch in cypher, indeed, we could scarcely realize the idea that letters would reach their destination so frequently as they appear to have done. The problem of aërial transit has hitherto baffled the ingenuity of men to invent any method for guidance and control, although many devices have been contrived by scientific experimenters on the mechanism of flight and motion, but if ever success should be achieved in this direction, a great advantage will be conferred on the resources of military operations.

As regards the nursing of the sick and wounded, this duty both during peace and war, is always efficiently performed in France by the Sœurs de Charité, who are considered as an integral part of the regular military and civil hospitals. They do not usually minister in the field-hospitals during war, but wherever they may be employed, they invariably display the same precise obedience to orders, and earnest zeal in the performance of their benevolent mission, partly due no doubt to the result of previous training, but chiefly probably to the absorbing influence and control of their religious vows.

The preparations for war stimulated the patriotic feelings of the ladies of Paris, who organized themselves under the direction of a Committee, loyally presided over by the Countess Flavigny, for the purpose of undertaking personally the nursing of the sick and wounded in the numerous private ambulance establishments. Most efficiently was this self-imposed obligation fulfilled by all ranks and creeds, each of them evincing the same cheerful self-denial, and enduring patriotic devotion throughout the entire period of the siege, and displaying the most tender solicitude for the suffering of the wounded, whose personal wants they supplied, often no doubt softening the heart of many a wounded soldier, by gently touching an inward chord, which thrilling through the departing spirit, may have wafted it to a happy eternity. "When pain and anguish wring the brow, a ministering angel thou,"—and the brightest, or possibly only bright page of any future history of the siege, must be that which describes the untiring practical sympathy evinced by the ladies of Paris, in the cause of suffering humanity.

We must all lament the sad misfortunes which have overtaken the military prestige and genius of such a great nation as France, which

relied on the success of her arms, from associations with the traditions of their past glories, forgetting that the art of war has developed into a science, requiring the application of high educational powers to sustain it. The causes of the repeated defeats of the French Army in the late war have been so fully and fearlessly described, in the French Chambers, by General Trochu, that it would be presumptuous in me to allude further to the subject, unless it be to express a hope, that France our former gallant ally, may profit by the lesson of her present temporary humiliation, and like the fabled Phœnix of old, re-appear from her ashes, not only a wiser, but a better nation.

In conclusion, let me not forget to acknowledge with grateful remembrance, the protection of a merciful Providence, by which I have been spared to relate my "experiences and reminiscences of the memorable siege of Paris," and also to tender you the expression of my best thanks for the patient hearing you have accorded to my feeble efforts.

APPENDIX.

Proportion of Casualties in the following important Battles:

	French losses.	Austrian Losses.
Austerlitz	14 per cent.	44 per cent.
Wagram	13 „ „	14 „ „
Moskowa	37 „ „	44 „ „
Waterloo	36 „ „	31 „ „ (Allies)
Magenta	7 „ „	8 „ „
Solferino	(Franco-Sardinian) 10 per cent.	8 „ „

Instruments for Detection and Extraction of Lead or Iron.

The original porcelain probe devised by M. Nélaton for the wound of Garibaldi.

Modifications devised by Surgeon Major Wyatt.

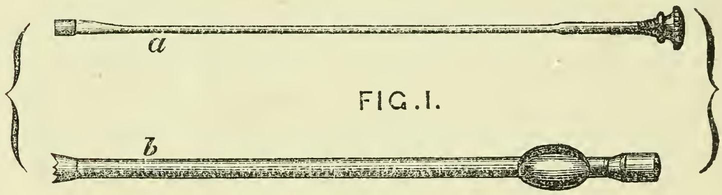


Fig. 1.—Porcelain probe and sheath for protection from blood in deep wounds. *a,* probe; *b,* sheath.

FIG.2.

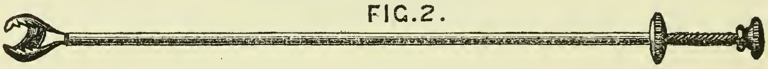


Fig. 2.—Forceps extractor for fragments of lead or iron.

FIG.3.

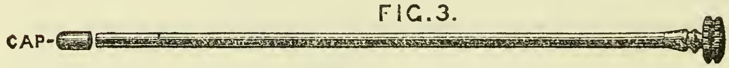


Fig. 3.—Magnet detector for iron or steel.

FIG.4.

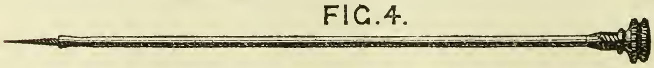


Fig. 4.—Gimblet screw extractor for bullets of any shape or size.

SOCIÉTÉ DE SECOURS AUX BLESSÉS MILITAIRES. ÉTAT GÉNERAL DES OBJETS À LA DATE DU 28 JANVIER, 1871, SUR LE PROVENANT DU DON ANGLAIS.

Désignation Générale des Objets acquis.	Montant.			Observations.
		Brut.	Net escompte déduit.	
I. DENRÉES ALIMENTAIRES.				
Vin de Bordeaux	..	5,932,600		
——— Bourgogne	..	2,336,490		
Mise en bouteilles	..	1,579,500		
Malaga, Zucco, &c.	..	750,375		
Cognac et rhum	..	455,135		
		11,054,100		
Escompte	..	8,445	11,045,655	
Café	..	1,344,000		
Escompte	..	47,040	1,296,960	
Sucres	..	..	1,409,805	
Thés	..	109,385		
Escompte	..	3,830	105,550	
Chocolats	..	..	1,916,625	
Miel	..	..	108,950	
Compotes et confitures	..	600,900		
Escompte	..	23,110	577,790	
Biscuits, &c.	..	..		
Fruits à l'eau-de-vie	..	..		
Tablettes pour potages	..	998,645		
Escompte	..	6,920	991,725	
Légumes conservés	..	..	330,975	
Arrowroot	..	..	51,250	
II. VIANDES.				
Viandes conservées	..	8,768,725		
Viandes sur pied	..	..		
Vaches	54	5,071,820		
Porcs	12	43,750		
Nourriture	..	668,850	14,946,895	
III. VETEMENTS.				
Chemises de flanelle	7,726	4,282,425		
Gilets de flanelle	2,921	1,691,440		
Tricots de laine	606	44,090		
Paires de chaussettes de laine	10,608	1,391,550		
Caleçons	1,140	936,125		
Flanelles en pièces	574	80,460		
Escompte	..	882,290 154,775	8,668,225	
IV. DIVERS.				
Tabacs, cigares, and net	..	575,445		
Vinaigres et savons	..	200,375	775,820	
Total général	..	..	42,680,830	

ETAT BI-HEBDOMADAIRE DES BLESSÉS ET MALADES, DANS L'AMBULANCE D— DE LA SOCIÉTÉ DE SECOURS AUX BLESSÉS

✠ MOUVEMENT DU AU .

	Régions du Corps.	Restant sur le Dernier Etat.	Entrés à Nouveau. Venant Directement du Champ de Bataille.	Entrés à Nouveau. Venant d'autres Ambulances.	Entrés à Nouveau. Blessures provenant De balles.	Entrés à Nouveau. Blessures provenant D'obus.	Entrés à Nouveau. Blessures provenant D'Armes Blanches.	Entrés à Nouveau. Amputations Immédiate.	Entrés à Nouveau. Amputations Secondaire.	Entrés à Nouveau. Resections Immédiate.	Entrés à Nouveau. Resections Secondaire	Entrés à Nouveau. Autres opérations.	Morts par Infection purulente.	Morts par Hémorrhagie.	Morts par Gangrène.	Morts par Tétanos.	Morts par	Morts par Maladies internes.	Evacues Sur d'autres Ambulances.	Evacues Autres destinations.	Rentrés au corps.	Restant dans l'Ambulance.	Observations.
1	Contusions																						
2	Plaies des parties molles sans fracture																						
3	,, pénétrantes des yeux																						
4	,, ,, du cou																						
5	,, ,, de la poitrine																						
6	,, ,, de l'abdomen																						
7	Plaies pénétrantes avec fracture ... des os du crâne																						
	,, de la face																						
	,, de la colonne vertébrale																						
	,, du thorax																						
	,, du bassin																						
	du fémur																						
	des os de la jambe																						
	,, du pied																						
	,, du bras																						
	,, de l'avant-bras																						
	,, de la main																						
8	Plaies perforantes des articulations Coxo-fémorale																						
	Genou																						
	Tibio-Tarsienne																						
	Epaule																						
	Coude																						
	Main																						
9	Maladies internes Fièvres Exanthématiques																						
	Fièvres Typhoïdes																						
	Typhus																						
	Bronchite																						
	Pneumonie																						
	Phthisie																						
	Diarrhée																						
	Dyssenterie																						
	Scorbut																						
	Affections des Yeux																						
	Autres Maladies																						
	Totaux																						

Observations on the Temperature during Two Months of the Siege.

December 1870.				January 1871.			
Date.	6 A.M.	Noon.	Midnight.	Date.	6 A.M.	Noon.	Midnight.
1	27·5°	36·5°	25·1°	1	20·2°	24·2°	21·8°
2	21·8	28·2	25·6	2	20·5	23·0	20·7
3	30·7	37·4	34·8	3	21·7	27·1	20·5
4	27·0	27·2	20·5	4	16·2	19·3	14·0
5	19·6	26·6	27·1	5	11·2	19·0	33·8
6	25·7	31·1	27·7	6	34·6	40·0	36·6
7	27·2	32·0	30·8	7	37·4	43·1	36·0
8	29·3	32·0	32·0	8	32·0	36·5	33·1
9	31·5	34·6	26·9	9	30·1	32·0	30·8
10	22·2	27·1	24·4	10	29·9	32·0	29·7
11	21·7	23·0	24·9	11	24·7	27·1	24·5
12	26·9	36·7	37·7	12	18·8	25·1	24·4
13	37·6	41·0	44·6	13	26·1	32·0	24·4
14	49·1	51·8	51·5	14	19·0	24·0	18·8
15	45·5	55·0	54·9	15	17·5	19·8	31·2
16	44·2	48·2	43·5	16	34·1	39·5	37·5
17	41·8	46·2	44·5	17	38·8	43·1	36·3
18	37·7	45·1	43·1	18	35·7	41·0	34·8
19	44·3	46·6	46·3	19	34·1	37·5	34·5
20	46·8	48·2	39·2	20	32·0	37·9	34·7
21	31·4	28·5	21·9	21	34·5	39·5	35·6
22	18·5	19·7	17·2	22	36·2	40·4	35·2
23	15·5	21·1	14·9	23	35·6	40·5	35·8
24	10·3	16·3	12·5	24	33·7	36·3	34·1
25	11·0	20·4	21·0	25	32·7	34·1	32·0
26	20·2	26·8	18·2	26	28·1	30·9	26·1
27	16·1	16·7	18·6	27	19·3	25·9	25·6
28	19·0	23·0	22·5	28	24·3	27·9	28·0
29	20·7	26·4	16·6	29	27·3	31·1	30·6
30	15·4	20·1	22·2	30	29·4	31·5	30·5
31	20·1	22·3	20·3	31	29·9	34·4	31·2

List of Current Prices during the latter part of the Siege of Paris.

	Francs.		Francs.
A turkey	190	1 lb. sausage of dogs	8
A goose	150	A pigeon	18
A hare	80	A box of sardines	7
A rabbit	60	A crow	6
1 lb. fresh butter	60	A sheep's brains	6
A fowl	50	1 egg	3
1 lb. ham	50	A rat	3
A cat	25	A sparrow	1
1 lb. sausage of horseflesh	8	1 apple	1½

LECTURE.

Wednesday, February 12th, 1873.

Colonel SIR W. HENRY GREEN, C.B., K.C.S.I., F.R.G.S., in the Chair.

THE CENTRAL ASIAN QUESTION.—I.

By Captain F. Trench, 20th Hussars, F.R.G.S.

The Central Asian Question which we have met here this day to discuss is, as I need hardly say, a very wide one, and has many sides, historical, political, strategical, and geographical, from which it may be discussed.

It would be difficult, however, more especially in a limited lecture like the present, to convey any very clear idea of the whole question, as it stands at the present day, without approaching it, more or less, from each of these points of view.

I propose, therefore, to divide my lecture into several parts, and deal, as far as possible, with each side of the question in turn, as it will thereby, I think, be rendered more convenient to discuss, and, I hope, more interesting to you all.

I will, then, begin with a brief historical sketch of the whole subject, from its earliest origin down to the present day. Long before the period that Russia, first emerging from political chaos and barbarism, began to take any prominent part in European politics, the idea of founding a vast Eastern empire held a foremost place among the various schemes that her rulers had conceived for their self-aggrandizement. Though before the end of the XVIIth century, her nominal conquests had reached the far eastern extremities of Asia, yet the encroachments of her early adventurers were confined to the northern portion of the continent. Peter the Great, following up the policy and projects of his predecessors, was not slow to grasp this idea in all its bearings, and to perceive how the geographical position of his rising empire with Asia, stretching to a boundless extent eastwards, favoured the development of such a scheme. He may be said to have been the first ruler of Russia who advanced his frontiers towards the more central portion of the continent, and who, by ceaseless encroachment upon his neighbours, smoothed the way towards the attainment

of his country's traditional aims. It was not, however, until the beginning of the present century that the idea of English supremacy in India being threatened by Russian invasion was first seriously entertained. Hence the "Central-Asian Question," *i.e.*, in plainer language, the question of the relative positions towards each other of Russia and England in Asia, may be said to date its birth from the year 1800. For nearly three-fourths of a century since then the present and future aspect of this question has been productive of endless argument and discussion, and from time to time, as new events have developed new phases in its aspect, it has led to no small difference of opinion, both among military and political writers.

Hence it will, I think, be as well in the following sketch to mark the varying phases through which this feeling of "Russophobia" has passed.

The main and prominent idea which has generally, at any rate up to a very recent period, been maintained by Russophobists and alarmists was that Russia had a fixed intention of gradually creeping up to a position from which she might invade, or at any rate have the power of invading India, if at some future time it might suit her to do so. And in fact, although it has been the fashion of late to deride such apprehensions as these as the illusions of a bygone day, yet they were natural enough some years ago, and may be said to have been fully justified by historical facts. On no less than four different occasions during the present century has an invasion of India by European Powers been either distinctly contemplated or planned.

The first of these was in 1800. In that year, during the short-lived alliance between the Emperor Paul I and Napoleon, while both were equally concerned in assailing the power of England, the latter, while yet First Consul, proposed a joint French and Russian invasion of India. The projected plan of operations was as follows:—It was agreed that 35,000 French, under Massena, should proceed to Ulm and descend the Danube to the Black Sea, from whence a Russian fleet was to transport it to Taganrog, that it was then to move to the Volga where it would find boats to convey it to Astracan, at which point it was to be joined by 35,000 Russians and 50,000 Cossacks, amply provided with artillery and horses, and the combined armies, consisting in all of 120,000 men, should then be transported across the Caspian Sea, from Astracan to Astrabad, where magazines of all kinds were to be established for its use. The march from the frontiers of France to Astrabad was estimated at 80 days, and 50 more were required to bring the allied forces to the banks of the Indus by the route of Herat, Farrah, and Candahar. So far, indeed, were the preparations for this scheme arranged, that the Hetman or Commander-in-Chief of the Cossacks, Count Orloff Denisoff, received orders to march on India with all the regiments of the Don. The rescript of the Emperor Paul with reference to this, is to be found in the Appendix to Milutin's "History of Suwarrow's Campaigns," published at St. Petersburg in 1853.

It is scarcely necessary to remark that such a scheme as this, feasible as it might possibly be at the present day, would at that time have been

utterly impracticable, and the fact that such a genius as Napoleon seriously entertained it, illustrates, I think, in a striking manner, the very crude ideas of the extent and geography of the countries of Western and Central Asia then prevalent in Europe.

Though subsequent events arrested the attempt to carry this project into effect, yet the idea which Napoleon had entertained as a General, was revived by him some seven or eight years subsequently, when he had become Emperor. In the year 1807, he proposed to the Emperor Alexander of Russia an invasion of India by a confederate army which should unite on the plains of Persia. With this view the French Emperor opened negotiations with the Shah of Persia, to induce him to join in the scheme, and intended to send his brother, Lucien Bonaparte, to arrange the details of the proposed campaign. In fact, it was no secret that the two Emperors intended in the course of the spring of 1808 to undertake an expedition against the British possessions in the East.

The details of this proposed enterprise, which were fully and elaborately arranged, are, I think, not very generally known. They are to be found in one of the secret articles of the Treaty of Tilsit, and were as follows:—

" France and Russia, in conjunction, to march an army to the banks " of the Indus.

" Austria to allow the French troops to march through her territories, " and to assist their descent down the Danube to the Black Sea.

" A Russian force of 35,000 men to assemble at Astracan—25,000 " regulars and 10,000 Cossacks—this force to be conveyed across the " Caspian Sea to Astrabad, there to await the arrival of the French " troops. Astrabad to be the rendezvous of the combined army, to " contain the magazines for military stores and provisions, and to be " the central point of the communications between France, Hindustan, " and Russia.

" The French division of 35,000 men to embark in boats on the " Danube, and to sail down that river to the Black Sea.

" On their arrival there, to proceed in transports, supplied by Russia " across the Black Sea and the Sea of Azov to Taganrog, to pass " thence up the right bank of the Don to the small Cossack town of " Pèah Izbianca, and to march thence by land to the city of Czaritsin " on the right bank of the Volga, to embark on the Volga, and to " descend to Astracan. From Astracan to embark on the Caspian " for Astrabad.

" On the junction of the French and Russians at Astrabad, the " combined army immediately to begin its march, and to proceed by the " cities of Meshed, Herat, and Candahar, to the Indus."

" The computed duration of the march of the French division from " the place of embarcation on the Danube to the River Indus was 119 " days."

The next scheme for the invasion of India is one which, I think has scarcely ever been made public, or at any rate is known to comparatively very few. It was by an entirely different route, viz., by *the Valley of the Euphrates*, and was planned by Napoleon a year or two after the

Treaty of Tilsit. My authority for this statement is the late Major-General F. R. Chesney, who in a letter to me upon this topic written now more than three years ago, says as follows:—

"Mr. Vincent Germain, assistant to the French Consul at Aleppo, "when I landed in Syria in 1831, informed me that he had been em-"ployed by the Emperor Napoleon in 1810, to make all necessary "arrangements and inquiries with a view to the construction of rafts "from the forests behind Marash, and by these means to descend to "Bassorah, his proposed pivot of operations against India, after "landing his army at the mouth of the Orontes." He goes on to say, "From information given me in Syria, and now in my possession, there "can be no doubt that Napoleon contemplated the invasion of India "by the line of the Euphrates, as well as by the united operation with "Russia from Astrabad."

With regard to the scheme recently made public, and alleged to have been drawn up in 1854 by General Duhamel, it was of course only to be expected that at a time when there was war between England and Russia, either Power would endeavour to strike her adversary in any vulnerable point she could find. At any rate, it can scarcely be maintained that there is either in the conception of the project, or in the proposed method of carrying it into effect, anything that could be very surprising or unexpected to any one who is acquainted with the general history and tendency of the relations between Russia and England in Asia ever since the commencement of the present century.

Returning from this short digression, I will resume my narrative of the history of Russophobia, and the events which developed that feeling in England during the early part of the present century.

During the next few years subsequent to 1807, there were no signs of this feeling on the part of the Ministers of this country and their supporters. Their opponents, the Whigs, alone ever betrayed its existence, and then without any power to give it effect. It would take too long here to show how for some years the Emperor Alexander I, by the frequently oscillating offers of his alliance to France and England, contrived to gain the alternate connivance of each Power in his constant accessions of territory. At last his share in the final overthrow of the Great Napoleon made him in England the very idol of Tory adoration. Nothing asked by him was refused. Not only was Poland given up to him as his reward, but at the very same time the Treaty of Goolistan, brought about, strange to say, by British intervention, dictated terms of peace by which Persia ceded to Russia all her territories immediately south of the Caucasus, and the absolute dominion of the Caspian, which thenceforth became a Russian lake.

After the treaty of Goolistan, concluded in the year 1814, there was peace between Russia and Persia for ten or twelve years. It was, however, only surface deep, and in 1826 there was again war between the two states. A short campaign followed, and in 1827 Persia was again glad to sue for peace, and Russia was enabled to "rectify her frontier" at the expense of her humbled foe. Strange and incomprehensible as it may appear, the British Government was again so blinded to its own ulterior interests, that it not only did not prevent,

but actually smoothed the way to the ratification of this treaty, which bound Persia hand and foot to the Court of St. Petersburg, and advanced the Russian frontier not only nearer to India, but also to the Valley of the Euphrates.

From the date of the conclusion of this treaty (called the Treaty of Turkomanchai), Russia was obliged to cease from enlarging her territory at the expense of Persia by open and undisguised aggression inasmuch as owing to a change of Ministry in the English Cabinet, she felt that any such acts would be too jealously regarded by Europe in general, and that by England in particular any further open acts of spoliation would probably be followed by an appeal to arms. The Russian Cabinet, however, was at no loss for means of using the resources and influence of Persia for her own ends. Count Simonich, the Russian envoy at the Court of Teheran, did not cease to urge on and encourage Persia to transgress her legitimate boundaries eastwards, or to hint that she might indemnify herself for her losses in the West by fresh acquisitions in the East. Encouraged by these representations, Persia contemplated in 1832 the reduction of Herat, which had for some time previously refused to acknowledge allegiance to the Shah. In this scheme he was strenuously encouraged by the Russian envoy as for several reasons it was a desirable object to his Government to further the conquest by Persia of Herat. Reports and rumours soon found their way to India, to the effect that the co-operation and assistance of Russia would soon be apparent in this enterprise, and that a confederate Persian and Russian Army would advance upon Herat, and after its reduction threaten India. Surmises and rumours such as these, vague and untrustworthy as they might be, served to show the feeling prevalent in the public mind, and consequently Russophobia which had for some time been quiescent, now began again to disturb the political vision of English and Anglo-Indian statesmen. Meanwhile the Persian preparations for the expedition against Herat were pushed on with vigor, and in 1833 the undertaking was actually commenced, but was shortly afterwards, owing to the death of the Crown Prince, abandoned for a time. In 1837, however, in spite of the urgent representations of the British Minister at the Court of Teheran, the long contemplated campaign was recommenced in earnest at last.

For the last five or six years it had been evident that affairs in Central Asia had been taking a turn to which neither statesmen in England nor in India could afford to be indifferent or to overlook. It had long been obviously the true interest of Great Britain to preserve as far as possible the integrity of the Persian Empire, so as to keep it out of the hands of Russia, and free from her influence, in order to act as a barrier against any designs of encroachment eastwards which that Power might carry into effect, either directly, or by putting forward Persia to promote her own ends, and to mask their real significance. With this object in view, it was specially important to render British counsels at the Court of Teheran at least equal to those of Russia. The efforts, however, of the British Minister at the Court of Teheran to do this had signally failed, and when the long-threatened danger to Herat, which was then, as now, asserted to be the

gate of India, seemed really imminent, Russophobia, which had for some time been smouldering in the public mind, blazed forth into a flame, and for the next two or three years may be said to have been, both in India and England, at its height. Journalists and essayists discussed the question in all its bearings, and bringing forward formidable arrays of arguments and facts, were prepared to prove beyond contradiction that Russia was intriguing with the view of the ultimate invasion of India. It was the more easy to do this, as the peril seen through the misty haze of ignorance was greatly magnified, and was believed to be imminent.

Under these circumstances it was obviously the interest of the Indian Government to secure Affghanistan as a barrier against Russian encroachments. Accordingly it endeavoured to make an alliance with Dost Mahomed, but having bungled in that, it hit upon the notable expedient of endeavouring to replace Shah Soojah, a deposed and exiled King of Affghanistan, upon the throne. This attempt to force an unwelcome king upon the Affghans was the actual event which ushered in the Affghan war. Whatever may have been the ostensible pretexts for that undertaking, the primary cause of it was Russophobia, and the war itself eventually became nothing more than an expression of defiance against supposed Russian designs.*

For the next eight or ten years after the English Army finally evacuated Affghanistan we studiously avoided all intercourse with the country, and the feeling of Russophobia which had in 1838 risen to fever heat, had, in the absence of any events calculated to evoke it again, time to cool down and become dormant. In 1851, however, events occurred which showed that this feeling, though somewhat dormant in England of late, was still capable of being easily evoked. In that year Persia again meditated sending an Army against Herat, and had she done so, there is but little doubt that the city, owing to intestine dissensions, would have fallen an easy prey into her hands. But the English Cabinet was scarcely likely to suffer this. Accordingly, by means of a threat of the suspension of diplomatic relations, she compelled the Shah to sign a treaty, by which he pledged himself to evacuate the Affghan territory. Following close upon these events, came the Crimean war. Persia, seeing that anarchy still prevailed at Herat, and knowing that England at that time had her hands full,

* In the somewhat recriminatory correspondence on the subject of intrigues in Central Asia, which took place between the English and Russian Governments in 1839, Count Nesselrode wrote a despatch (which was by the Emperor's special consent laid before Parliament), of which the following is an extract:—"The Emperor "of Russia," he said, "ne veut que ce qui est juste et ce qui est possible. Par ce "double motif il n'admet point une combinaison quelconque dirigée contre la puis-"sance Britannique aux Indes. Elle ne serait pas juste, parce que rien ne l'aurait "provoquée. Elle ne serait pas possible, à cause des distances immenses qui nous "séparent, des sacrifices qu'il faudrait faire, et tout cela pour réaliser une concep-"tion aventureuse, qui ne saurait jamais s'accorder avec une politique saine et raison-"able. Un seul regard jeté sur la carte devrait suffire pour dissiper à cet égard "toute préoccupation, et pour convaincre tout homme impartial et éclairé, que nul "dessein hostile envers l'Angleterre ne saurait diriger en Asie la marche de notre "Cabinet."

seized upon the moment as favourable for reviving her old scheme of encroachment eastwards. Accordingly her troops in the beginning of 1856 actually occupied Herat. This occupation was immediately recognized by the British Government as a "casus belli," inasmuch as it was done in defiance of England, and in direct contravention of the treaty of 1852. At the conclusion of the war which followed, Persia was glad to purchase peace on the condition that she abandoned Herat, which she engaged to do, by a treaty concluded at Paris in 1857.

During the seven or eight years that succeeded the Treaty of Paris, Russophobia, strange to say, passed in England through a reactionary phase, so to speak, and may be said to have been succeeded in the mind of the majority of English politicians and the larger section of the English public, by the most complete indifference. And yet, indifferent as we generally seemed to be upon this subject, there were ever, to an attentive observer, indications sufficiently plain that a feeling of insecurity lurked beneath our apathetic exterior, and that England was not so easy upon this point as the principal organs of her press professed her to be. As almost year by year vague rumours of fresh Russian successes and further conquests reached us in England, the smouldering spark of mistrust again flickered forth into a flame, and the old cry, taken up first in India, and then re-echoed to England, would arise that England was sleeping while Russia was working, and that it became more and more evident that the invasion of India was the goal of her hopes and machinations. But the more influential portion of the press, representing the optimist opinions of the quietists, hastened to assure the English public that this was but a resurrection of the old bugbear that had so often frightened it before, and which all sensible and dispassionate men had long ago numbered with the theories and opinions which, though they were cardinal points in our fathers' political creed, we of a younger generation had been wise enough to discard. We were assured that Russia, in thus adding province to province, was merely yielding to the necessities of her position, brought into contact as she was with savage fanatical tribes; that the phantom of Russian invasion was an illusion of bygone days; that Russophobia was a disease chronic amongst Anglo-Indians; that England had in reality nothing to fear; and that even granting that there was ultimate danger to our Indian empire, she would do much better to await Russia's onset, sheltered by the range of the Himalayas, than by endeavouring, by the dubious aid of treacherous Asiatics, to thwart her progress while yet she was afar off. But there were many statesmen and politicians, and those too of a high stamp, and reflecting in their opinions much of what is most high-minded and best in English political feeling, who went much farther than this. Yielding to the impulses of a generous but certainly a misguided optimism, and priding themselves somewhat (though it may be unconsciously) upon the liberal and enlightened spirit in which they viewed this question, they professed to hail with pleasure the prospect of England's Indian frontier being one day conterminous with that of Russia, as our difficulties in controlling and managing capricious and fanatical peoples would then be at an end, and we should be able to establish political and

commercial relations on a firm basis with a civilised Power. The advocates of this somewhat Utopian theory were in the habit of using rather grandiloquent language on the subject, which perhaps after all did not mean very much. They would adduce it as a happy dispensation of Providence, and a gain to the interests of humanity and the welfare of mankind, that the barbarous countries of Central Asia should be brought under a strong European Government, and that even Russian civilisation, though perhaps not of the highest type, should introduce law, order, and security, where, from time immemorial, there had been nothing but the most hideous oppression, cruelty, and misrule.

Reassured by such statements and arguments as these as to what was the true policy of England in this matter, viz., to bide her time, to consolidate her power in India, to do her duty towards her millions of Asiatic subjects, and meanwhile to let matters in Central Asia take their course, public opinion in this country was well content to dismiss the matter from its thoughts until again startled and disquieted by the news of some fresh stride of Russian annexation, when it has been content to be again comforted by the same assurances. It is curious and at the same time somewhat instructive to note how these phases of public opinion upon this topic seem to repeat themselves. At intervals varying from three years to ten, according to circumstances, public interest in the matter is aroused, and the whole question is revived and discussed by the press in all its bearings; then the discussion gradually dies out for want of fuel upon which to feed, and for two or three years, or perhaps for five or six, no one would imagine that such a question had ever existed at all. This is what happened in 1865, when the Russians took Tashkend; it happened in 1868, when they captured Samarcand; it is happening now again in 1873, when they have announced their intention of invading Khiva. In conclusion of this part of the subject, it may be remarked that Russophobia in England has in our time veered round so as to present quite a different aspect from that which it had in days of old. In the last generation, when this feeling was at its height, and when the nearest Russian outposts were hundreds of miles further from our frontier than at present, the ruling idea was that India might be threatened by a Russian army advancing through Persia, and Herat was accordingly always regarded as the key of the Anglo-Indian house. Nowadays, however, when the Russian frontier is close to Affghanistan, and when there is every prospect that that country alone will intervene between the British and Russian possessions, the idea of invasion, strange to say, has been abandoned as utterly irrational. In fact, it is allowed to vanish with the candid confession that it was, in those days, at any rate, a baseless fabric, a distempered dream from first to last. Instead of this, the general public has begun to acquire another and a far truer insight into the contingencies which the neighbourhood of Russia to our Indian frontier may entail. It is seen that Russia, by thus steadily pursuing her career of conquest, may gradually be able to creep up to a position so near to our frontier as to exercise at pleasure a disturbing force, and to render us uneasy for the tranquillity

of our dominions. This, I need hardly say, is a danger which we are bound, if possible, to prevent.

Part II.

Thus far I have dealt with the political history of this question. I will now pass on to a very brief geographical sketch of Central Asia.

The portion of Central Asia more immediately connected with the subject under discussion may be divided into three sections. Of these the southern section is Affghanistan, the south-western is Turkestan proper, in which may be included Russian Turkestan, and the three nominally independent Uzbeg Khanates of Khiva, Bokhara, and Kokand. Turkestan proper, as distinguished from Eastern Turkestan, comprises an immense area. It may be described in general terms as stretching from the Caspian Sea on the west, to Eastern Turkestan, or Chinese Tartary, on the east. For its northern boundary a line may be drawn almost from the southern shore of Lake Issyk-Kul, westwards along the River Chui, and then on to Fort Perovski, after which the boundary is marked by the Syr right up to the Aral Sea; thence the line may be continued due westward to the Caspian. Turkestan may be divided into four sections, viz., the three Uzbeg provinces of Khiva, Bokhara, and Kokand, and Russian Turkestan.

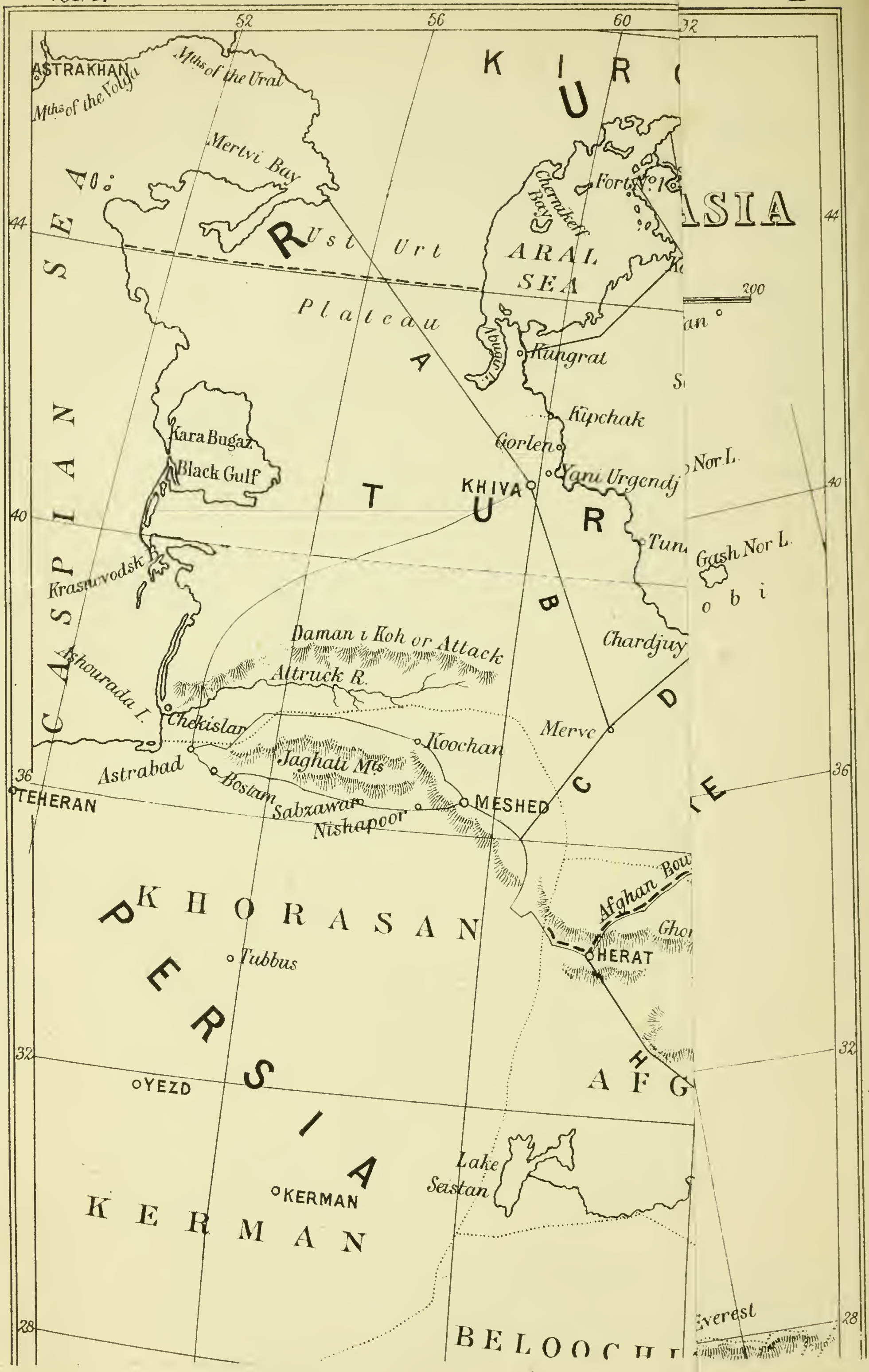
The western portion of this region appears to be a vast desert plain, unrelieved by any mountains, whereas in the east it is intersected by numerous mountain ranges. The most northerly of these are the Karatan and Boroldai mountains, while the most southerly are those whose melted snows feed the sources of the Oxus.

The two great rivers of this region are the Syr or Jaxartes, and the Amoo or the Oxus. The first of these, *i.e.*, the Syr, one of the largest rivers in Asia, is mainly formed by the confluence of three tributaries, the Naryn, the Gulishan, and the Jumgol. Nearly half way from its source it enters the Khanate of Kokand, still retaining its character of an impetuous mountain stream. On emerging into the plain below Khojend, it becomes navigable, and remains so to a greater or less extent throughout the whole of its lengthened course. Its navigation, however, is still beset with many difficulties and drawbacks, in consequence of sandbanks, shifting currents, and the great shallowness of the water in some places. The Russians, however, have already made, and are still making great efforts to render it a convenient highway for their steamers into the heart of Turkestan.

The other great river of this region is the Amoo, or Oxus. It takes its rise in the Lake of Sar-i-kul, situate in the great plateau of Pamir, between 300 and 400 miles south of the Syr. It is 1,700 miles long, and has a large number of tributaries in the upper part of its course, but none whatever in the central and lower portion of it. It becomes navigable for heavy barges near Kunduz, has an average depth of 9 feet, and inundates its banks in June and August. Its width varies between 140 feet near Kunduz, and 3,000 feet near Bent. At its mouth it forms an extensive delta, dividing into a number of wide but shallow streams, mostly inaccessible to ships of any kind. The easternmost


MAP OF CENTRAL ASIA
English Stat. Miles
100 50 0 100 200
Railways completed
Do. in construction
Do. projected
KIRGIS STEPPE
RUSSIAN ASIA
ARAL SEA
CASPIAN SEA
TURKESTAN
KHIVA
BOKHARA
KHOKAN
EASTERN TURKESTAN
CHINESE EMPIRE
KHORASAN
PERSIA
KERMAN
AFGHANISTAN
BELOOCHISTAN
CASHMERE
PUNJAB
SINDE
RAJPOOTANA
NEPAL
OUDE
TIEN SHAN PELU
Desert of Gobi
Himalaya Mountains
Karakorum Mts
GULF OF OMAN
ASTRAKHAN
TEHERAN
MESHED
HERAT
KABOOL
KANDAHAR
KELAT
YEZD
KERMAN
LAHORE
DELHI
LUCKNOW
ALLAHABAD
BENARES
CALCUTTA
HYDRABAD
Kurrachee
Kashgar
YARKAND
Samarcand
Tashkend
Kokand
Kuldja
Peshawur
Attock
Mooltan
Quetta or Shawl
Ghuznee
Bamian
Jelalabad
Balkh or Takhtapul
KUNDUZ
Merve
Kirghiz
Afghan Boundary 1873
Sandy Desert of Kizil Kum
Kara Kum Sandy Desert
Aralsk Fort
Fort No 2
Fort Perovskie
Ust Urt Plateau
Krasnovodsk
Astrabad
Chardjuy
Karshi
Hissar
Meimana
Gilgit
Chitral
SIRINAGUR
Mt Everest
KHATMANDOO
Patna
GWALIOR
JEYPORE
JESSULMERE
BEEKANEER
BAHAWULPORE
ODEYPORE
MUSCAT
BUNPORE
LAR
Gombroon or Bunder Abbas
Strait of Ormuz
Gwadel
Lake Seistan
Ganges River
Jumna R.
Indus R.
Sutlej
Ghogra River
Sone R.
Hoogly
Kopal
Ft Vernoe (Almaty)
Turfan
Karashar
L. Bostang
Lob Nor L.
Gash Nor L.
Aksu
Khotan
L. Balkhash or Dengiz

J. Jobbins


ASTRAKHAN
Mths. of the Volga
Mths. of the Ural
Mertvi Bay
CASPIAN SEA
Ust Urt Plateau
ARAL SEA
Chernikeff Bay
Fort No. 1
ASIA
Kungrat
Abugir
Kipchak
Gorlen
Yani Urgendj
KHIVA
Kara Bugaz
Black Gulf
Krasnovodsk
TURKESTAN
Gash Nor L.
Chardjuy
Daman i Koh or Attack
Attruck R.
Ashourada I.
Chekislar
Koochan
Merve
Astrabad
Jaghati Mts
Bostam
Sabzawar
Nishapoor
MESHED
TEHERAN
Afghan Bou
HERAT
KHORASAN
PERSIA
Tubbus
YEZD
AFG
Lake Seistan
KERMAN
KERMAN
BELOOCH
Everest
52
56
60
44
40
36
32
28

arm of the delta, called Karabaila, and further down, Ulkan Darya, is the deepest and the most navigable of them all, but even this has only an average depth of several feet along a considerable portion of its course, and in the high-water months of June and August, converts the whole country into a lake, where every trace of the ordinary channel is lost in a wilderness of reeds and swamps. The Amu Darya freezes only in January, is flanked by numerous canals, and is famous for the taste and salubrity of its water. There being no wood on the banks of the river, steam navigation would entirely have to depend on coal depôts, to be formed at fixed distances. The Amu discharges its water into Lake Aibugir, which, in the high-water months, coalesces with Lake Aral, but is ordinarily separated from the latter by a broad isthmus, along which a caravan road lies. There are no more than nine ferries all the distance between Kundush and Lake Aibugir, and no bridges further down than the Ak Serai*.

With regard to these two rivers, which play so prominent a part in the geography of Central Asia, it may be observed as a remarkable fact, that the banks of both of them are nearly uninhabited, as the principal centres of population, with the sole exception of Khojend, are at some distance from their banks. This circumstance is attributed by Russian writers to the plague of hornets, mosquitoes, and other insects generated in the morasses and swamps that are to be found on each side of their banks throughout a great portion of their course.

Though, as will be seen from a glance at the map of Central Asia, throughout a great portion of the regions comprised under the name of Turkestan there extend (more especially towards the west, in which the means of irrigation are more scanty) vast sandy deserts and barren steppes, such as the deserts of Kizil Kum and Batak Kum, yet this is by no means the case as regards the whole area of the three Khanates. There are certain large districts in these regions which yield to none in fertility, and in the general wealth and variety of their productions. M. Vambery indeed goes so far as to assert that "it might be difficult "to find in Europe, flourishing as it is in every blessing, territories that "would rival the more fertile portions of these Khanates."

Part III.

Having completed this somewhat cursory geographical sketch of the regions which are the subject of discussion on the present occasion, I will now pass on to a brief narrative of the events that have within the last few weeks brought the affairs of Central Asia upon the *tapis*.

In the month of November last, in consequence of numerous outrages and insults committed by the Khivans against Russian subjects and the Russian Government, and other ample provocation, an expedition under Colonel Markosoff was sent against Khiva. This expedition turned out disastrously; for the Russian Force, after nearly reaching Khiva without meeting with opposition, was surprised and forced to

* For a more full and accurate geographical description of these regions than can be given in a limited lecture like the present, the reader is referred to the "Russo-Indian Question," pp. 32—47. Macmillan and Co. 1869.

retreat. I need hardly say that the Russians can no more afford to be beaten in Turkestan, than we could afford to be beaten on the banks of the Sutlej. Consequently, a regularly organised expedition upon a tolerably large scale is now being prepared with a view to decisive operations in the coming spring. The projected plan of campaign as at present proposed is as follows:—Three Russian columns will march against Khiva. One will start from Krasnovodsk of about 3,000 men and 20 guns, one from Djuzak of 5,000 men and 10 guns, and one from Orenberg consisting of 2,000 men and 10 guns. The column from Djuzak will cross the Oxus at Tunuklu, the point where the boundary of Khiva meets that of Bokhara. The column from Krasnovodsk, it may be remarked, will be composed entirely of troops drawn from the army of the Caucasus, which according to the most recent accounts is 167,000 strong, of which about 100,000 can be placed at once on a war footing. The Russian Government have been careful to represent to the English Cabinet the smallness of the forces they intend to send, viz., some 8,000 men, as a proof that they have no intention of permanently occupying the country. I do not think, however, that this goes very far to prove any such intention, for in all military operations in regions like those of Khiva, you are confronted with this choice of difficulties, viz., that if you take a small army with you, you are beaten; if, on the other hand, you take a large one, you are starved. Whether the Russians will eventually keep Khiva it is impossible at present to say. Of course, every one who has watched the course of affairs in Central Asia, must have known that its ultimate annexation, or at any rate its complete subjection was merely a question of time. I think it is most probable that Russia will deal with it as they have done with the greater part of Bokhara, that is, that they will maintain a kind of protectorate over it, and leave to the ruler the somewhat troublesome task of governing his own fanatical subjects. But, however this may be, I think that, looking at the geographical position of Khiva, there can be no doubt that Russia will retain at any rate certain strategically advantageous points in the country, so as to secure for herself a permanent right of way through it. The Khanate at present separates Russia's isolated newly-acquired territories in Bokhara and Khokan from the Caspian. The River Oxus, moreover, runs through the centre of it. At present the quickest and most practicable route between Turkestan and European Russia is across the Caspian and Aral Seas, and thence up the River Syr. The water-communication, however, by this route, is broken by the wide intervening plain of the Ust-Urt, between the Caspian and Aral Seas. It is, moreover, very circuitous and slow. If, however, the Russians have a permanent right of way through Khiva, they will be able to open up a far shorter route to their outlying dependencies in Turkestan. How great its advantages will be are here apparent, when I state that by adopting it, Russian troops proceeding from the eastern shores of the Caspian to Samarkand will save about 700 or 800 versts by going through Khiva, instead of by the circuitous route up the River Syr. It may be mentioned that Krasnovodsk Bay, the point where the new route is to be opened out, is nearly exactly opposite Bakou,

on the western shore of the Caspian, which was originally meant to be the eastern terminus of the Poti and Tiflis Railway, destined to connect the Black and Caspian Seas. This railway is already open as far as Tiflis.* When these works are finished and in working order, it is obvious that any troops in Southern Russia will be rendered easily available for service in Central Asia. That the Russians have long contemplated getting possession of a more direct route to the Oxus is evident from the fact that more than three years ago the "Invalide Russe" discussed the measures necessary to secure its safety. The "Moscow Gazette" also four years ago spoke of the new proposed route as follows:—"Now that our merchants have been permitted to "trade and settle in Bokhara, they are sure to abandon the roundabout "route by the River Syr, and to effect direct communication by the "Amu Daria and the Krasnovodsk Bay of the Caspian Sea."

There is yet another way in which the possession of the Khanates of Khiva and the Oxus may possibly be of the greatest advantage to Russia, which is as follows:—

There is very little doubt that in old times the River Oxus flowed into the Caspian Sea. In a very interesting paper, written some five or six years ago for the Russian Geographical Society and translated by Mr. R. Michell, it is stated that many recent travellers who have visited the eastern shore of the Caspian Sea, affirm that they have seen in Krasnovodsk (or Balkan) Bay the embouchure and bed of a large desiccated river, in some places 100 fathoms wide and 15 deep, which is considered to be undoubtedly the mouth and channel of the dried-up course of the Oxus or Amu. The river is said by the inhabitants of those regions to have been diverted by the Khivans more than a hundred years ago, and at present there is a large dam near Kohne Urgendj which prevents the waters of the Oxus from pursuing their course to the Caspian. Hence the possibility has often been discussed in Russia of destroying this dam, and turning this great river by its old bed again into the Caspian, and then making the stream navigable throughout. If Russian engineering skill could succeed in effecting this, it will be seen at once how great would be the strategical and commercial advantages which such a work would secure. Russia would then have water carriage, and that by a far more direct route than at present, for her troops and her merchandise from the heart of her European provinces down to the very gates of Hindostan, viz., from the point where the Volga becomes navigable to Kunduz in Affghanistan, where the Oxus begins to be navigable.

From several translations of Russian documents which I have seen, I think there can be little doubt that an attempt will be made to carry this great project into effect, and I believe that sanguine hopes are entertained of its ultimate success.

Even supposing the present course of the Oxus is allowed to remain undisturbed, the possession of the Khanate of Khiva is necessary in order to allow them to navigate it without hindrance throughout its whole course. In examining the future aspect of the question, it is

* It has lately been decided that this railway should not be extended from Tiflis to Bakou, on account of the great physical difficulties of the route.

as well to keep this contingency in view, viz., that of the Russians having some day a direct waterway from the Caspian right into Affghanistan—the more so, as I think it is a point to which public attention has as yet not been drawn.

I will next say a few words about the fort of Tchickislar, and the valley of the Attreck, of which during the last few weeks we have heard so much. First, as to the position of this fort. It is not marked upon any of the English maps which I have seen, but according to a Russian map and plan of the place which I was shown a few weeks ago, Tchickislar is on the right, *i.e.*, the northern bank of the river Attreck, and certainly not more than 10 miles from its mouth, if it is so much. Secondly, it may be stated that its occupation by Russian troops is no new event, as seems to be generally supposed. In 1859 a Russian force, under command of a Colonel Dandeville, was sent to attack the village and fort of Tchickislar. This force having landed and taken the place from the Turkoman garrison who held it, occupied it for a short time. In the Russian work, from which this account is taken, the expedition is alleged to have been sent at the request of the Persians, with the ostensible object of releasing a number of Persian captives enslaved by the Turkomans. When this had been done, the Russians evacuated the place, and re-occupied it in 1871, evidently with the primary object of having a *point d'appui* from which to attack or keep in check the Khivans from the south, in their contemplated operations against Khiva. That this position was useful to them in this respect is evident from the fact that in the recent unsuccessful expedition of the Russians against Khiva, one of the Russian columns started from Tchickislar, which was in fact its base of operations. It is no secret, moreover, that Russian boats and small ships have often ascended the Attreck for a short distance, more especially some 10 or 12 years ago, when a survey was being made of the eastern coasts of the Caspian.

With regard to Tchickislar being on Persian territory, supposing the northern frontier of Persia to extend as far as the Attreck, instead of only to the Goorgan, as has often been alleged, the fact of the place being on the northern bank of the Attreck, would seem to show that it can scarcely be said to be situated upon territory to which Persia has any shadow of a claim. The question as to whether it is or was ever Persian territory does not, however, affect in the smallest degree the main point of importance involved, viz., that if the Russians are free and able to navigate the Attreck for any distance up stream, they would be able, in case of need, to transport troops and military stores by water carriage somewhat nearer to Herat than it has hitherto been considered possible for them to do.*

Part IV.

I will now go on to give a short account of the diplomatic correspondence which has recently been exchanged between the Govern-

* Since this lecture was given, it has been ascertained that the Attreck is not navigable for ships and boats of any size, except for a few miles just above its mouth.

ments of England and Russia concerning the proposed line of demarcation, or "intermediary zone," as it is becoming the fashion to term it, that it is proposed to draw on the north of Affghanistan. This correspondence may be briefly summarised as follows :—

In the year 1869, the late Lord Clarendon, in consequence of the steady advance during 1868, of Russian conquest in Central Asia, and in a south-easterly direction to Bokhara, Samarkand, and Karshi, thought it expedient to address the Cabinet of St. Petersburg on the subject of Central Asia, and suggested, that in order to prevent future political complications, some line should be drawn, beyond which Russia should not extend her career of conquest. In reply, the Russian Government naturally enough expressed its readiness to recognise an Affghan frontier, as of course nothing would suit her better than a line of demarcation of this sort drawn so near the Anglo-Indian frontier. Hereupon a correspondence ended between the two Governments, and though it was admitted by both sides to be desirable that the matter should be definitely settled, no agreement was come to. In the course of the negotiation which followed, the Russian Government promised to furnish the late Lord Clarendon with a definite exposition of its views upon the matter. The subject then remained in abeyance for a time. In October last, however, Lord Granville re-opened the correspondence, and reminded the Russian Government that it had not yet received the long promised document explaining the wishes of the Cabinet of St. Petersburg upon the proposed boundary line. At the same time he explained at some length the views of the English Government, and finally proposed the northern limits of the neutral territory, so that the provinces of Badakshan and Wakhan should be included therein. With regard to the rest of the line, he proposed that it should strike the Oxus at Khojah Salih, midway between Termez and Kerki, and run thence to the Persian frontier. In reply Prince Gortschakoff announced his willingness to agree in the main to the line of demarcation proposed, with the single exception of the provinces of Badakshan and Wakhan, which, for alleged political reasons, the Russian Government did not think ought to be included in the intermediary zone. With this despatch Prince Gortschakoff also forwarded an historical sketch of the provinces referred to, viz., Badakshan and Wakhan. At this stage of the negotiation His Imperial Majesty the Emperor of Russia, hearing of the great distrust and alarm created in England by the contemplated expedition against Khiva, and the alleged occupation of the Valley of the Attreck, sent over Count Schouvaloff, in order to re-assure the English Government as to the intentions of Russia in Central Asia, and to allay the anxiety that evidently existed in the public mind. Amongst other civil and polite things which the Emperor's Envoy is reported to have said, was, that his Imperial master was determined in the pending settlement of the precise boundaries of the proposed intermediary zone, that there should be no cause of difference between the two countries, and that he was confident that a final arrangement might be arrived at at an early date.

Upon this footing the negotiation at present seems to rest, and a

very unsatisfactory footing it is; a point upon which I think all will agree who have considered the actual circumstances of the case.

The first thing to be noted is, that Count Schouvaloff did not, as has been generally supposed, come over to England in consequence of any communication addressed by the English Government to the Government of St. Petersburg, but because it was seen that the public mind in England was thoroughly alarmed. It is evident moreover, that these districts which the Russian Government is so anxious to be able to clutch when she is ready to take them, and which our Government are so anxious to keep out of her clutches, are very important in some way or other to both sides. It will be well, therefore, to point out in what their importance consists. This I will now proceed to do, in as few words as possible.

The provinces of Badakshan and Wakhan may be said to be the most northerly outlying dependencies of Affghanistan—in fact they form the north-east corner of the region that is generally included under that name, and are conterminous on the north with the Khanate of Khokan.

The western corner of these provinces almost touches the present Russian boundary in Turkestan. On the east they are bounded by the Bolor Dagh mountains, a ridge traversed by several practicable passes intersected by small tributaries of the Indus. Both provinces are very little known to European travellers, and indeed Wakhan may be said to be almost a *terra incognita*, as it is quite unexplored.* Badakshan, however, is well known to be one of the finest countries in Asia, and is certainly one of the richest. It produces every description of fruit, is renowned for its coal and ore, and boasts a greater variety of jewels than even India or Brazil. The wealth and beauty of the capital, called Faizabad or Badakshan, was formerly a favourite theme of Oriental poets, but the city is in ruins now.

Though the rulers of Affghanistan have generally claimed sovereignty over these provinces, yet the inhabitants, as a rule, own allegiance in reality to none but their own virtually independent chiefs. Shere Ali, however, the present ruler of Affghanistan, has succeeded to some extent in making good his claim to their allegiance, for in 1869 many of these rulers, in the presence of Lord Mayo at Umballa, swore fealty to him and to his throne. It is worthy of remark that Peter the Great was recommended by one of his envoys 150 years ago, to take possession of this very province of Badakshan. Indeed, that Monarch appears to have been served by some Ministers as daring in their conceptions as himself. An Italian named Flori Beneveni, the Russian envoy at the Court of Bokhara in 1724, when making a report to his Imperial master in 1724 on the wealth of Badakshan and other regions of the Oxus in valuables and precious stones, finished his report with these words, "My last word to your Imperial Majesty is this, if you wish

* For a most able and exhaustive description of these regions, so far as they are known, see "An Essay on the Geography of the Valley of the Oxus," by Colonel H. Yule, C.B., published as an introduction to "A Journey to the Source of the River Oxus," by Captain John Wood, Indian Navy. New Edition. John Murray, Albemarle Street, London. 1872.

" to confer a permanent benefit upon your exchequer, you might easily " do so in these regions. Your power would carry everything before " it, and be a sufficient reason in itself." After this short digression I will resume the thread of my argument.

3rdly. It is evident that the English Government made no remonstrance, as has also been generally supposed, to Russia as to the contemplated expedition to Khiva. And indeed notwithstanding all that has been recently alleged on the matter, it is difficult to see how, looking upon the real facts of the case, any remonstrance upon this score would, with any show of reason or of justice, have been addressed by England to Russia. In the first place, Russia has doubtless received ample provocation from the Khivans, and has therefore a perfect right to exercise the right of retaliation upon her foe; secondly, if when Russia, in 1868, took possession of Samarkand and other towns in the Khanate of Bokhara, which are hundreds of miles nearer to the frontier of Affghanistan than any towns of the Khivan Khanate, England held her peace, and showed thereby that she deemed it no concern of hers, it would indeed have been straining at a gnat and swallowing a camel if our Government had raised any outcry when, with good and ample reasons, Russia makes an attack upon Khiva. In fact, the Government by so doing would at once have placed itself in a false position.

I will now proceed to point out the probable future difficulties of the position in which we shall probably find ourselves placed. It is evident that in proposing to Russia a line beyond which her career of conquest shall not extend, that we have given her direct encouragement and tacit permission to advance up to that line, a hint which, we may be sure, she will not be slow to avail herself of when it suits her to do so.

Again, our avowed intention of defending Affghanistan implies a permanent alliance with the reigning Ameer of that country, an engagement which, as all who are acquainted with Indian history will admit, entails no slight responsibilities.

Next, with regard to the power of disturbance which will be possessed by Russia. It is clear that we cannot hope to escape with impunity by reason of the terms which we have prescribed. When we have virtually, with the exception of the intermediary zone, partitioned Central Asia with Russia, and have said to her, " thus far shalt thou come and no farther," we must be prepared to act with promptitude and decision the moment she does come farther, and to repel her by force. Hence it follows that Russia will be able at any time that suits her purpose to compel us to go to war by simply crossing the line of demarcation which we have drawn; in fact, we shall have to defend a far distant frontier as we now defend the frontier of the Punjab. If Russia wishes to find a pretext for meddling in the affairs of Affghanistan she will never have very far to seek for it. For what is the condition of that country?

From time immemorial the nemesis of Mahomedan polygamy has thrown its curse over the land, and rival members of the reigning house, sons of the same father but by different mothers, have ever, when opportunity presented itself, endeavoured to gain possession of

the throne. As a natural consequence the country, whenever the ruler for the time being dies or is deposed by one of his rivals, is torn with intestine dissensions: murders, insurrections, anarchy, and bloodshed are of frequent occurrence. Any bold, daring adventurer who aspires there to political power, would at any time find himself backed by thousands of turbulent followers, who would be ready at any time to take advantage of any circumstances that would be likely to forward their schemes of self-aggrandisement. Such is the country which it is proposed to convert into a neutralised buffer between England and an aggressive intriguing Power like Russia. Who that knows anything of the Affghans, and indeed of Orientals in general, can doubt that as soon as Russia touches Affghanistan there will always be a Russian party in the State ever looking hopefully to Russia for encouragement and support, ever breathing defiance to England and the reigning Ameer of the country, whoever he may be. Not the least remarkable point in this state of affairs is the fact that not only do we let Russia come up to the borders of Affghanistan, but we actually propose that she should do so. It is said that all parties in Russia are anxious that the arrangement proposed by England should be accepted. There is but small reason to doubt that, for people generally are satisfied when they have got exactly what they want. This arrangement will, in fact, enable Russia to make rapid strides southwards by treaty instead of by force of arms. Sooner or later it was of course inevitable that some agreement should be come to between the two Governments, but virtually to invite Russia to make her future frontier in Turkestan conterminous along its whole line with Affghanistan, is to ask her to come nearer than is either pleasant, agreeable, or safe. It has long been foreseen that the time must come when England must make a stand and speak out her mind bluntly upon the subject, and the settlement of the question will in no way be facilitated by concealing the grave issues at stake, or by postponing the time for decisive action in the matter. I say this, because there seems to be in some quarters a disposition to quiet matters over in this important question, to prophesy smooth things, generally to hush the subject up, and to represent that it is likely to be soon settled once and for all.

I repeat then, that if Russia is enabled by treaty to creep up any nearer to our Indian frontier than at present, she will have got all she wants, and the idea will go forth upon the continent, as well as in Asia, that we were willing to accept any arrangement sooner than run the risk of a quarrel. It would surely be more dignified for a country like England to reflect that nothing worth having can be won, nothing can be retained without corresponding danger and risk, and therefore, with set purpose steadfastly to accept the fact, that the peace and possession of India are important enough to warrant our facing and braving the responsibilities inseparable from the guardianship of such a prize.

Such being the present aspect of affairs, it is certainly very strange to read the opinions expressed of late by some of the leading organs of the press, who believe, or at any rate affect to believe, that the Central-

Asian Question has for the present been set at rest. The truth is, that the real difficulties of the question are just about to begin. Whichever course the Government may pursue is beset with difficulties, but to let Russia come any nearer to India than at present, is the worst course of all. When we have permitted her to establish herself on the borders of Affghanistan, she will be in a better position than ever to carry one of her most obvious manœuvres into effect, viz., that of neutralising or checkmating the opposition of England in any project she may wish to render an accomplished fact, by maintaining a threatening attitude in Turkestan.

In conclusion, those indeed must be sanguine politicians who can persuade themselves that the Central Asian Question can be lulled to rest, that it will cease to exist, or that in some unexplained fashion it will solve itself. On the contrary, as years pass on, and as Russia is enabled to open out new and improved communications with the as yet isolated provinces she has just acquired in Turkestan, the importance of the question must ever assume larger proportions, and the proximity of Russia to India must ever be one of the most awkward political complications with which English and Indian statesmen will have to deal. In the future as heretofore, England's difficulty will be Russia's opportunity. It was so in 1870, when she tore up the Black Sea Treaty. It was so in 1837, when she instigated Persia to attack Herat, and finally persuaded her to carry the attempt into effect in the very year when there was a good prospect of the military forces of England being required in an opposite part of the world, viz., to quell a threatened insurrection in Canada. During years of peace, and so long as any designs which she may have in Europe or in Asia are not thwarted or interfered with by England, Russia will probably in no very active way trouble herself with India and its concerns. But, whenever any question of European diplomacy arises in which the interests of the two countries are directly opposed, or are likely to clash, her power to stir up mischief or to threaten our actual or political frontier, will have to be taken into account, because the difficulty which has so long been looming in the future will then have to be regarded as ever present and permanent. The fact is an unpalatable one, but it is useless to disguise it. Hence on all accounts it is advisable at once to look this danger boldly in the face, and to realise the risks and contingencies to which our position in India may in the future be exposed. By adopting such a course we shall be less likely to lose sight of the fact that in such a question as this professions of mutual confidence, esteem, and good-will between two Cabinets cost just as little as they mean, and we shall on this account be scarcely disposed to risk any of our material interests to a hollow confidence in the permanently peaceful intentions of a rival and ambitious Power.*

* At the date of the delivery of this lecture, the correspondence between Prince Gortschakoff and Lord Granville on the subject of the proposed Affghan boundary had not been generally published. It appeared in the papers the same evening.

Part V.

The strategical side of the Central Asian Question is an interesting study, and one on which a great deal might easily be said. In order, however, to discuss it at length, and in a manner that would be satisfactory to myself and to my audience, would make far greater demands upon our time than it would be possible on the present occasion to concede. I must therefore fain content myself with dealing very briefly with this portion of my subject.

When our present Indian frontier on the west and north-west was fixed, there was no prospect of the proximity to it of a strong European Power. Strategically, I suppose no one would maintain that it could not be much improved, but hitherto it has served our purpose well enough. Many schemes have from time to time been propounded for its rectification and improvement, ranging in scope and aim from a slight advance beyond our present position to the occupation of Candahar. Of these schemes, however, there is at present only one, which I propose on the present occasion to notice. It was first suggested some years ago by that sagacious and clear-sighted soldier, General Jacob, and it has again been very recently brought forward in an able and interesting pamphlet by our Chairman, Colonel Sir Henry Green,* who has kindly consented to preside upon the present occasion, and who in consequence of his having been long in high political employ upon the Western frontier of India, is thoroughly acquainted with the subject. I refer to the occupation of Dadur and Quettah in Beloochistan, belonging at present to the Khan of Khelat. The importance of these two places lies in the fact that they command both sides of that important avenue into and out of Western India, viz., the Bolan Pass, which is the only practicable route by which an army could, on the side of Persia and Beloochistan, successfully advance against India. The town of Dadur on the Indian side of the Bolan Pass is only about 60 miles from our present frontier, and Quettah is about 70 miles more. If in addition to this occupation of the Valley of Quettah, the town of Dadur were joined to the Indian railway system at Sukkur on the Indus, the strategical advantages that would accrue from this measure are obvious. We should hold the most important and practicable pass into Western India, and if ever a Russian force did advance towards Affghanistan through Persia, we could always from our advanced post at Quettah, attack or threaten it in flank.

In addition to this, I may add that we should incur no hatred or animosity on the part of any native state by taking up this position. The Khan of Khelat is one of our firmest allies, and we have a treaty with him enabling us to take up this position if circumstances should seem to render it advisable. He is, moreover, fully alive to the advantages which a subsidy from the Indian Government would give him and his subjects.†

* On this subject see a pamphlet by Colonel Sir H. Green, K.C.S.I., C.B., entitled, "The Defence of North-West Frontier of India." Harrison, 59, Pall Mall, 1873.

† See pamphlet above referred to.

There is another and a notable scheme, which has often been proposed as a sure means of improving and shortening our communication with India, and also of immensely strengthening our strategical position in that country, and a lecture on the Central Asian question would obviously be incomplete without a reference to it. I refer, I need hardly say, to the Euphrates Valley railway, which is closely connected with the name and labours of that distinguished soldier, the late Major-General F. R. Chesney. In spite of his earnest and life-long efforts, besides those of others, to promote this great undertaking, and notwithstanding that the whole of the proposed route has been thoroughly surveyed, hitherto it has seemed that this project is as far off an actual commencement as ever. The proposed course of the railway is from Alexandretta, or Scanderoon on the Mediterranean, to the head of the Persian Gulf, and would be about 850 miles long. The great strategical and political advantages which it would secure for England are so well known, that I will only very briefly recapitulate them here.

1st. It would connect the Mediterranean with the Persian Gulf.

2nd. It would enable troops from England to be landed in India in seventeen or eighteen days.

3rd. It would subject an enemy advancing towards the north-western frontier of India to easy attack in the flank and rear.

4th. By making Kurrachee the European port of India instead of Bombay; it would save about 900 or 1,000 miles in the distance between England and India, and would reduce the time occupied in the journey by nearly one-half.

5th. It would render the resources of England far more promptly available in the East than at present. As long as Turkey was our ally it would be easily defensible, as both termini of it would be upon the open sea.

6th. It would put an end to the dangerous isolation of Persia, and would relieve that country from the undue pressure to which she is now subjected by Russia.

7th. In the event of Turkey being again allied with England against Russia, the railway would afford great facilities for throwing a British force from the Mediterranean or from Bombay, and so threaten or hold in check Russia's troops on her Trans-Caucasian frontier, where she has always considered herself safe from attack.

These are, it will be admitted, great and important advantages. There are, however, two sides to every question, and this scheme is no exception to the rule. There are, obviously, certain risks and disadvantages which the construction of this line, under English auspices, and with English money, would entail. These are, I think, somewhat apt to be lost sight of by enthusiastic advocates of the project, but they are certainly contingencies which neither statesmen nor soldiers are likely to overlook.

It must be borne in mind that the proposed line is to run wholly through Turkish territory. The Turkish Government, which is said to be most anxious for the construction of the line, might possibly be always friendly to England, and guarantee us the use of the route, but at the same time she might not always be our ally. We declined to

stand by her in 1870, when Russia tore up the Treaty of Paris, and she may well doubt whether we should fight for her again, as we did 18 years ago. She might well decline, therefore, to make any great sacrifices in our behalf. Again, take another case, and, it must be owned, a possible one. Russia might be at war with Turkey, and some of the provinces through which the line is to run might be the theatre of that war. In such a case, an endeavour would certainly be made by Russian troops to seize the line, if by so doing it was possible to paralyse the action or threaten the communications of their enemy. In such a case England might find herself in the somewhat false position of having made the line, and not being able, it might be in the time of some great emergency, to use it. So long as England and Turkey were allied together against Russia, there would be but little danger of our not being able to hold the line against all comers, as both its termini would be on the sea, and it would be protected both by the Tigris and Euphrates rivers throughout the whole of its course. Any Russian force, moreover, would have to advance a very considerable distance through an enemy's country, swarming with Mahomedan horsemen, before it could reach the line. There are other political complications which might very possibly arise, which will readily suggest themselves to every reader, but which it would occupy too much time to dwell upon more fully on the present occasion. Speculations, however, such as these, it may be said, are only possible and remote contingencies, while the immediate advantages to be secured by the construction of the line would be direct, obvious, and certain. Looking at the matter impartially, and without prejudice, it may fairly be said that the latter far outweigh the former, and it is to be hoped that some really practicable steps will now be taken towards making the Euphrates Valley route to India an accomplished fact. As, however, in the event of the line being made, it has been estimated that it will require some ten millions of money, it is well before taking such a project in hand, in every sense to count the cost, and to weigh well the possible risks and dangers to which that route might in the future be exposed.

Major Poore: Mr. President, Ladies, and Gentlemen, in dealing with this subject it is very important that we should understand the nature of the Government at St. Petersburg. Of course it is the general supposition that the Government at St. Petersburg is something of the same nature as any other Government of European nations. But it is not so: the Government of St. Petersburg is composed not of Russians, but almost altogether of foreigners: the history of its composition is a curious one, and dates back from the time of the low Greek Empire, and the scheme of empire is one as old as the taking of Constantinople itself.

The Russians were converted to Christianity at the time of the Patriarch Photius in the ninth century, and a body of priests and learned men to form a nucleus, were chosen by him to proceed to Russia. After various oscillations, at the close of about a century, they and their successors converted the country, and alliances were made between the reigning house in Russia and the reigning Emperor of Constantinople. When the Turks took Constantinople, the Greeks who had been accustomed to the leading places in their country, would not remain in it, nor would they go to their enemies of the Latin Church; a few went to Florence, but the great majority of them joined their brethren who were already powerful, and forming the governing party in Russia. The first result of this was the subjugation by the ruler of Russia of the Tartars, which was done by setting the different sections of the Tartars against one

another, then taking the part of the weaker against the stronger, and eventually crushing them both. After this, in the same manner they subdued the various free cities of Russia, which were in the most flourishing condition, of which perhaps Novgorod is one of the most remarkable. They were subdued by treachery, their leading men were carried to Moscow, and their peasants brought under the yoke of the Russian Greek Government. This continued under various able sovereigns, up to the time of Peter the Great, who very much developed the system, and whose policy has been considered to be delineated in that document called the will of Peter the Great, but which was no doubt of more ancient date than his time. The best proof of the authenticity of this document is found in the manner in which it has been universally carried out, in the various aggressions which Russia has made from that time. Peter the Great adapted or perfected the system he found, and being a man of great genius, with a capability of judging men's characters, he got all the unquiet and adventurous spirits he could collect from Europe to help him with his Government; this Government not being one of law, but a system of intrigue that had sprung out of that not very reputable state of things, the low Greek Empire. It can well be imagined that this is not an agreeable Government to the people of Russia, but as a body it has its strong points, one of which is the employment of trained talent. The Cabinet of Russia is composed of men trained on a continuous system, and it has for its antagonists, cabinets that are the haphazard of popular election, or rather the result of the factions or aimless revolutions of a country. These are all the obstructions that the mental efforts of Russia have had to withstand for the last 200 years.

It is not in Central Asia, but in Europe that Russia is to be opposed; to show the manner of this, I will mention an instance in which Russia has been successfully resisted, and some in which she has been unsuccessfully resisted. There was the remarkable instance that Captain Trench has alluded to in 1800, when it is evident that there was the idea, both in the mind of Napoleon, and in the minds of the Russians, of making an advance upon India. This was successfully resisted; how was it successfully resisted? Was it by any armed force? No, but by a few cruisers stopping the trade of Russia. It must be known that on account of the nature of the Government, of the immense territory that Russia possesses, and of the disaffection of her various populations, the executive is an exceedingly expensive one, and cannot be kept up except by the revenue on the exports of the country. If we call to mind the map of Russia, it will be seen that her exports are closed by two very small straits, one at the Dardanelles, and the other at the Sound, so that a few cruisers can hold Russia by the neck, and it is by the Right of Search,* and in the seas of Europe, that Russia has alone been successfully combated. Let us pass from this to the time when she has been unsuccessfully combated, one, the unsuccessful invasion by Napoleon in 1813, and the second, the far more disastrous Crimean War, in which in the supposed hour of victory, a pretended and unauthorised surrender was made of that right which from 1780 up to 1815, we held successfully against the whole of united Europe. And this at a time when Europe was in the hands of men of extraordinary genius.

Major BURNE: I feel that I am one of the last men in this assembly who has a

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* Lord Derby said 22nd May, 1856, of the Declaration of Paris, "Whatever losses "Russia may have suffered by this war, whatever embarrassments she may have "experienced by the adoption of that one article, gratuitously inserted by the French "and British Plenipotentiaries, by which in the words of Mr. Pitt, you *have sacri-* "*ficed the maritime greatness of England on the shrine of Russia*, the day will come "when the country will have cause to wring its hands in consequence of your acts, "and then we shall know on whose head to visit the decline and fall of British "maritime ascendency."

On the same subject Lord Hawkesbury said in 1802, "His Majesty will never con- "sent to place out of his hands, in a treaty of peace, those means which may be "necessary of the security of his dominions in time of war."

Lord Nelson: "England must sustain the Right of Search while she has a ship, a "sailor, or a shilling."

right to say much about the Central Asian question, but I wish to express to Captain Trench how much we all appreciate both his book and his lecture. I know that his book has gone throughout India, and those who wish to know anything about Central Asia have only to refer to it, to learn a great deal about the question. But mine must be the usual and easy task of finding one or two faults ; I am sure Captain Trench knows that I do it with the greatest friendliness. First of all, on the subject of drawing a line between Russia and India; as far as I know from an Indian point of view, of any proposal ever made to Russia on this matter, it was simply that we wished it to be understood in a friendly way that the territories south of that line we considered to belong to our ally the Ameer of Affghanistan, and that there we would not permit Russia to go. But that never gave Russia any ground for supposing that we were to support or connive at her aggressions north of that line. Captain Trench has drawn a correct sketch of Affghanistan as it was some years ago, but he must remember that the picture of anarchy was only a true one so long as Affghanistan received the cold shoulder from us. From the time that we have befriended her, since 1869, since the late lamented Viceroy received Shere Ali at Umballah, Affghanistan has been a scene of peace, and not of war, and is now a strong and friendly ally to ourselves. Badakshan was conquered by Dost Mohammed, the father of Shere Ali, in 1859, and from that period it has continuously belonged to Affghanistan. Was it likely that we, holding Shere Ali as our ally, would permit Russia to say Badakshan belonged to any one else? The only change Badakshan has made in her allegiance was that she veered from brother to brother of the Affghan dynasty during the trouble of 1864–68, but she never went to Bokhara, or any other power. I am sure Captain Trench will not object to my correcting these little errors in his valuable lecture.

In settling the Central Asian question—which probably none of us will live to see settled—we must remember two things. First, what value we are to give to the promises of Russia, and then what position we ourselves ought to assume. As regards the promises of Russia, we all know that they are worth very little. She took the Crimea from Turkey, and slaughtered 30,000 Tartar families at the moment she was carrying on a commercial treaty with Constantinople. We discovered in 1838 that she was trying to give Kandahar to Persia, under a secret Treaty, and when we found her out, she issued a manifesto, under Count Nesselrode's signature, saying the policy of the two nations was to be peace and tranquillity, and the preservation of the independence of all the lands lying between each ! While she was writing that document, she was organizing an expedition against Khiva, which fortunately was unsuccessful. Again, in 1864 Prince Gortschakoff told us that Russia had reached the limit of her empire. The ink was hardly dry, when she conquered the whole of Western Turkestan, ending in Samarcand. I have only to mention those three instances out of many others so show how little reliance we can place upon any engagement, treaty, or promise of Russia. The only thing left for us, therefore, is to comprehend what dependence we can have on ourselves. First of all, we have to look to Parliament ; but we hear one member saying, we must not resist Russia by a policy of annexation; another member says, "the matter of Khiva is a minor point." Another says, the settlement of the Badakshan limits is the settlement of the Central Asian question ; and so on. So that as far as we know, we can place very little reliance upon Parliament. Then how are we to depend upon ourselves? First of all, we must realise the fact that if any man takes a strong castle, he must have a strong wall round him, or he will lose his castle. Now that is, roughly speaking, our position in India. We have been too apt to vaunt our strength in India, and to ignore what is outside of us. Everybody knows what the Indian Government is trying to do, namely, to govern India justly, to make the native Princes strong, and the people happy, as far as we can, and thereby to add to the material progress of the country, and strengthen our position internally. But there is a still wider sphere of policy attached to that position, which is to see that our outworks are also strong. The policy of the late Lord Mayo, whose loss we all so deeply deplore, and whose broad, statesmanlike views on our relations in Central Asia are so well known, was to initiate a system of independent, strong, and friendly States all round India. If we once realise for a moment what that policy means in its entirety, Russia may take Khiva, or any other place she pleases in Central Asia, and we may laugh at her, and defend

ourselves without any more disagreeable feelings of Russophobia. Russia has got to the Valley of the Attreck, which is fertile, and blessed with good roads, leading down to Merv, Meshed, and Herat. She is also trying to establish herself in Yarkand, to capture Khiva, and to coerce Persia. We cannot actually protest against Russia taking Khiva, for if we do so, we only put ourselves into a false position, because we have no means of enforcing our protest. At the same time we can render it innocuous to ourselves by adopting a strong, careful, and decided policy of our own. If we carry on friendly negotiations with Affghanistan, Beloochistan, Yarkand, and all the other States surrounding India, and assist them when necessary with moral and material aid, we shall then establish a strong line of outworks round us, from which we may laugh at any foreign foe.

Sir Henry Green's plan, as a part of the Central Asian policy, is to occupy that place which Captain Trench referred to, Quettah. I know many people say we must not have an annexation policy, and so far they are quite right; but we must remember that what may have been considered four years ago to have been an annexation policy, is now simply a defensive one. We all know—I speak to military men—that you cannot defend any position without showing a few offensive qualities. In the present new state of things we must have strong outposts to defend our position in India, and if we take up those outposts at the request, or with the free consent of the States in whose territories they are, it is not annexation. By occupying Quettah, we guard against Persian encroachments, and Russian attack on Affghanistan, and we can thus possess a strong outpost from which we can not only observe events, but which gives to us a most valuable position. In considering the Central Asian question, or, in other words, our foreign policy as regards India, we must not forget that Turkey is also encroaching towards India. She has been doing so ever since we, in a measure, threw her over in regard to the Black Sea Treaty. She has taken a part of Arabia, and is trying to establish a fleet in the Persian Gulf. If we wish to realise what a valuable ally Turkey is to us, we have only to consider that as soon as we have completed our railways from Kurrachee to Peshawur, we have only to land a regiment of Turks in India as our friends to raise every Mohammedan in the place in the defence of India. The Mohammedans of India pray for the Sultan in every Mosque, and look to him as their chief in every way; so that with such a power for good or for evil, we must be very careful how we carry on our relations with Constantinople. I believe that if we look to these few little points, and comprehend the importance of dealing with our Eastern foreign policy with a *bold*, *decided*, and *broad* grasp, we shall preserve our position in India with ease, dignity, and power. I could say a great deal more on all these points, including the Euphrates Valley railway, but was quite unprepared to speak at all, and hesitate at this late hour to take up more of your time.

Mr. ROBERT MICHELL: I should like to say a few words on the subject of the excellent and elaborate lecture to which we have listened, and the very valuable and spirited remarks of Major Burne. If we had some time ago adopted the views advocated by Major Burne, I think we should very probably have stopped the recurrence of those alarms whenever we hear of a step made in advance by Russia. There are one or two points not touched upon. First as to the expedition to Khiva. We all now-a-days profess to be very humanitarian, and we always have had sympathy for slaves, and have done something to show it; witness our expedition to Abyssinia and the recent dispatch of a special Envoy to Zanzibar on the question of the slave trade. We are very likely to be moved by sympathy for the slaves whom the Russians are now going to release in Khiva. They say they have fifty poor miserable captives "languishing under all sorts of inhuman tortures," as Mr. Bernal Osborne said in Parliament. That is a little exaggeration. Of course there are slaves in Khiva, but we must not be quite blinded as to the object of Russia's plans in that direction; it is not solely for the purpose of releasing her slaves that Russia is projecting her expedition. Instead of 50, there are, I believe, only 37, and their names might almost be given. They are descendants of former slaves, runaway Cossacks, renegades and criminals, who escaped to Khiva, and who would not return if the Russians put ever so much pressure upon the Khan of Khiva to release them. Moreover, these slaves are pursuing various trades and callings, and are all of them better off than most of the poor Khivans, for many of them also fill the highest posi-

tions in the State. Attention has not been drawn to the telegram which appeared in the *Times* yesterday, and yet it was very important. If the Russians have promised to give up Khiva, if not immediately, then in three months, they will hold some point as a material guarantee till the Khan agrees to their conditions, which will be the right of entrance into the Oxus at all times, and all sorts of rights and privileges to traders, not to mention a very heavy contribution. If they do give up Khiva, and so fulfil their promise, they will not give up the line of the Attreck which flanks Khiva and all the Turkoman country from the south, a line which leads through a very practicable country, through a country called the Paradise of the Turkomans. The Russians have already demolished a Turkoman fort on this line of road which leads to Meshed and Merv. Mr. Venuikof, an excellent Russian authority, who has written a series of articles on the Russian military frontiers in Asia, gravely argues with reference to the line of frontier along the east coast of the Caspian, that it is worthless; there is no depth of water along the north-east coast, except about mid-way, in Balkan Bay. Asterabad Bay is the only other place in which vessels can find anchorage, and there at present, or rather at Chikishlar, by the Attreck, which, by the way, is not navigable, their main forces are now concentrated. It is obvious what the Russians are going to do; they are going to penetrate to the south, isolate the Mohammedan races one from the other, and then again revert to the process of a "rectification" of their frontier; this will bring them to the Oxus from the south, and give them communication with their Turkestan province from the Caspian, and when that line is drawn along the south, with Khiva and Bokhara left in the centre, the entire country will be absorbed, and then the governments of those places will be taken in hand; in the meantime they can very properly be left in the hands of the native rulers.

General Adye, C.B.: There is one point of which the gallant Officer who gave the lecture does not seem to be aware, namely, that in the *Daily News* of this morning, the last despatch of Prince Gortschakoff is given, in which he entirely assents to the views of England as regards the frontiers of Badakshan and Wakhan.

Mr. C. D. Collet: I think all of us who have heard this lecture must have been struck with the way in which Captain Trench brought out that seeming contradiction which there always has been between the reality of Russia's advance towards India, and the failure of every attempt she has made as against India itself. In fact, whenever this "Russophobia," as it is called, has taken place, we have always been induced to do something which Russia wanted us to do, and we have in every case carried out her view by a pretended or attempted opposition. To go no further back than the year 1836, the British Government concerted with Russia as to who should fill the throne of Persia. Lord Palmerston's instructions were to Sir John McNeil that he should advocate the Russian candidate, and so far from Sir John McNeil being allowed to prevent the Shah of Persia from claiming Herat, the Shah was constantly saying, "If you threaten us with war, I will not go," and Sir John was obliged to say, "I cannot threaten you with war." Then we were told that the Crimean War was a war for the defence of India; but what was the result of the Crimean War? There were two points which affected India, and one was the so-called neutralisation of the Black Sea. The meaning of that was that under the treaty neither Turks nor Russians were to send ships of war there; but a treaty is always good for what Russia may gain by it, but waste paper for what she grants. The Turks observed that treaty, but Russia did not observe it; she armed her merchant ships and seized every vessel that went to Circassia, and the consequence is that Circassia has fallen by the neutralisation of the Black Sea, which we considered was a triumph over Russia. Then came the removal of that neutralisation two years ago. We gave it up at once and endeavoured to impose terms upon Turkey which she refused, hinting very broadly that she considered us as a more dangerous neighbour than Russia herself. But what has struck me is that we forget the law of nations altogether respecting India. Edmund Burke said that as soon as a man doubled the Cape of Good Hope, he left his conscience behind him. By making any agreement with Russia that she shall not go beyond a certain boundary we undoubtedly do agree with her that she may go elsewhere wherever we do not forbid her to go, and by making this agreement also, we put ourselves in the position that the moment she oversteps the boundary she has agreed to keep, we are bound

to go to war with her. What is the state of things at this moment? It is said, "It has been for some years felt by the Governments of Russia and the "United Kingdom respectively"—England and Russia on the same line—"that it "would be conducive to the tranquillity of Central Asia if the two Governments could "arrive at an identity of view regarding the line which describes the northern frontier "of the dominions of Affghanistan." What should we say if those words were uttered with reference to some European power, if it had been said "It has been "for some years felt by the Governments of Prussia and the United Kingdom "respectively, that it would be conducive to the tranquillity of Europe if the two "Governments could arrive at an identity of view regarding the eastern frontier of "France." We should say that France is our ally, and how could we, without consulting her, propose to make her a neutral and to settle her frontier for her? It is altogether forgotten that if Affghanistan is our ally, she is the person who is to decide in these matters, and that we only come as her ally. If, on the other hand, we are considering her as a protected State, we are really taking possession of her and making an agreement with Russia against Affghanistan, under pretence of assisting her. But we are told we cannot say to Russia, "You shall not come to "Khiva," because we cannot prevent her coming to Khiva. It seems to be forgotten that India is a dependency of Great Britain, and that Great Britian is a maritime Power. I may recall what Major Poore so well stated, that in the year 1801 Russia went to war with us, and we beat her in seven months. The Russian Cabinet was compelled to assassinate the Emperor in order that they might make peace. Why were they compelled to make peace? Not by any expedition like that of Napoleon, not by any expedition like that of the Crimea, but by the simple operation of our cruisers and privateers throughout the Baltic. We seized all Russian property on the high seas, whether in the hands of vessels belonging to Russia or belonging to neutrals. What was the end of the Crimean War? One of the things was the neutralisation of the Black Sea which destroyed Circassia; the other was a declaration signed without any authority by which we declared that we would not seize an enemy's property in a neutral ship. So that while Prussia invading France is allowed to take anything she can on land, while, in fact, any military power is allowed to seize property on land, we declare that we will not seize the property of our enemies at sea, and consequently when we come to discuss a war between England and Russia, we have a miserable talk of getting an outpost from the Khan of Kelat. What is meant by "identity of view between the Governments of England "and Russia?" It means that England is to give up to Russia whatever Russia is ready to take now, and then at some future time Russia will take the rest. But we are not bound by the Declaration of Paris, which says we shall not seize an enemy's goods in neutral vessels. In the first place, under the immutable law of nations we could never be bound to do anything which is utter destruction to our State. In the second place, the laws of England cannot be changed without the consent of Parliament. And thirdly, no treaty can be made without, in the first place, the authority of the Crown, and secondly the ratification of the Crown.

The Chairman: I am sure that you will allow me, ladies and gentlemen, to return our best thanks to Captain Trench for his very interesting lecture.

Note by Sir Henry Green: The lateness of the hour at the close of Captain Trench's lecture prevented me at the time from making a few remarks which I had otherwise intended to have done upon some parts of his lecture. I now propose to do that in the form of a note, should the rules of the Institution allow of it. Captain Trench has shown how gradual, but nevertheless how certain, has been the progress of Russia towards India from the earliest date of her history as a nation up to the present time, when England has been forced to call upon her to define a limit to her future progress. This has been so clearly and ably described by Captain Trench, that it is unnecessary for me to dwell upon that part of his lecture. He has also shown that if the physical difficulties that would be encountered by Russia in any further advance are great, that they are nevertheless not insuperable, and that they would be principally met with beyond our northern frontier of India, between the southern bank of the Oxus and the Indus. On the western frontier of Affghanistan,

and by the roads leading through Persia from the Valley of the Attreck, and from Teheran to Herat, Candahar, and Quettah, all who have written upon the subject acknowledge the comparative ease with which a hostile army could approach our Indian possessions. It is to this line of advance that my attention has been mostly drawn. During a service of upwards of 20 years upon the Sind frontier, and in the adjacent country of Beloochistan, the subject was constantly present to my mind; and it was with a view to oppose the advance of an enemy in that direction that I have brought forward at the present moment the scheme of the late General Jacob.* Jacob proposed to occupy the Valley of Quettah, or, as it is sometimes called, Shawl, in Beloochistan. It is situated at the head of the Bolan Pass, thus closing, as acknowledged by all acquainted with that pass, the easiest road leading into India from the west. He further proposed the construction of a railway from Sukkur, on the River Indus, to Dadur, at the debouchure of the pass into India, and eventually to carry it even up the pass to Quettah itself. The whole distance would be about 200 miles, or 130 from Sukkur to Dadur, and 70 up the pass. Such a railroad would connect Quettah with the railway system of India, and place it within a couple of days' journey of Kurrachee, the seaports of the frontier. By the adoption of this measure the arguments of those opposed to the scheme, on the plea of the position being strategically a false one, on account of long lines of communication, want of supports, &c., &c., would be met. There are others, again, who fear the political difficulties that they imagine we should have to encounter; they talk about our being committed to fresh conquests and annexations, and that we might raise distrust in the minds of the Belooch, Affghans, and Persians. I think, however, that I can show that there is no occasion for entertaining these views; in proof of this I may mention that owing to the continued aggressive policy of Persia for years past towards both Beloochistan and Affghanistan, the British Government, in 1871 and 1872, felt called upon to interfere, and to despatch a commission to define the boundary between Beloochistan and Persia, as well as between Persia and Affghanistan. The success of this mission appears to be still doubtful, and must remain so until England takes up such a position as will compel Persia to respect these newly-defined boundaries. A glance at the map will show that Quettah would be such a position, and in occupying it we should be giving both moral and material support to our allies the Belooch and Affghans against Persia.

With reference to an expression which I have seen used, that by occupying Quettah we should break faith with the Khan of Khelat, in whose territory Quettah is situated, I may state that the late General Jacob—who beyond doubt forseaw that the day must come when an advance beyond the Bolan would become absolutely necessary for the safety of British India—in concluding a treaty with the Khan of Khelat in the year 1854 on the part of the British Government, included a clause as follows:—

> Clause 4.—"Should it be deemed necessary to station British troops in any part "of the territory of Khelat, they shall occupy such positions as may be "thought advisable by the British Authorities."

The Governor-General, Lord Dalhousie, in confirming this treaty, desired the following expressions to be conveyed to General Jacob:—

"The Governor-General in Council feels that he cannot praise too highly the "promptitude, the zeal for the public service, and judicious tact which you have dis-"played in your execution of the instructions addressed to you by the Government "of India in your successful negotiation of the treaty with the Khan of Khelat."

In the year 1865, when I held political charge and military command of the Sind frontier, I considered it necessary, for strategical reasons, to push forward permanently certain outposts beyond our own frontier into the territory of the Khan of Khelat. No objections whatever were offered by the Khan or his people; on the contrary, his Highness's remark was that whatever course of proceeding was for the benefit of the British must also be for his. Therefore, with his consent, and in accordance with the above clause of the treaty, and the sanction of the Indian Government, I occupied Sunree, Sooe, Goranaru, and Gundoe, in Beloochistan, and

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* See pamphlet entitled, "The Defence of the North-West Frontier of India," before referred to.

these are the most advanced British outposts in India towards the west. I feel now that the time has arrived for a still further advance; and I am convinced that if properly managed, it might be made with the same ease and with as little disturbance as in the case of that already effected.

With reference to the Affghans: during the year 1867, Noor Mahomed Shah, a shrewd able Asiatic, then Prime Minister of Shere Ali, the Ameer of Cabool, was residing for some two months within the British border as a guest of the Government. I was in constant personal communication and on the most friendly terms with him, and he frequently brought forward the subject of the occupation of Quettah, remarking how such a position held by the British would strengthen the Affghans against the aggressive policy of the Persians in Siestan; and in speaking thus I believe that he spoke the feelings both of his master and his people.

There is one more objection urged against the immediate occupation of Quettah, namely, that we can occupy it from our present position whenever we feel inclined to do so. Now at the present moment the Khan of Khelat, his chiefs, and people are our faithful allies, but we must remember that great efforts have been made, particularly during the war with Persia in 1856, and the Indian rebellion the following year, and will continue to be made by Persia, instigated most probably by Russia, to detach them from their alliance with us. Therefore, by placing ourselves at Quettah we place ourselves between them and the nations who have the most to gain by seducing them from their allegiance to the British. If we continue to shilly-shally below the pass, we may find to our cost that when we really want to advance beyond it and to close the easiest road leading into India, it may be in the hands of our enemies.

It is again argued that it will take years before Russia is in a position to attack India. I acknowledge this; but it will take a long time for us to occupy and consolidate ourselves at Quettah, and create such a strong position as will enable us to form a base for operations against an advance of Russia on Herat—an advance foreshadowed in an able work entitled "A Political Survey," by the present Under Secretary of State for India, Mr. Grant Duff, who, in a chapter on Central Asia, says:—"If we are foolish enough ever to allow Russia to possess Herat, we deserve "the worst that can happen to us." To launch a British Army into Affghanistan or Persia without such a base and without such a position to fall back upon in case of necessity would be madness. The day may come when there will be a rush for the possession of Herat, and it is to be hoped that when that day arrives we may not still be found "idly looking on from the Valley of the Indus on the movements "going on beyond the Bolan."

LECTURE.

Thursday, March 13th, 1873.

General SIR WILLIAM J. CODRINGTON, G.C.B., Vice-President, in the Chair.

THE STRATEGY OF RUSSIA IN CENTRAL ASIA, FROM A PERSIAN POINT OF VIEW.

By Captain R. Murdoch Smith, R.E., Major in Persia and Director of the Persian Telegraph Department; Fellow of the Royal Geographical Society; author of "History of the Recent Discoveries at Cyrene."

In opening the present discussion on the Strategy of Russia in Central Asia, I would beg to preface my remarks by a brief explanation of my reason for venturing to submit them.

Our interests in the East are of such vital importance, that I consider it only the duty of every Englishman, who has any special means of studying the question of their defence, to come forward with his views, however incapable he may be of giving expression to them. Actuated by this feeling, I have, with great diffidence and some reluctance, yielded to a request to address you on the present occasion; and I have been still further induced to do so, by a conviction that the present solicitude in England with regard to our position has, on the whole, been directed to a quarter from which there is comparatively little to be feared.

A continuous service in Persia ever since 1863 naturally led me to take a special interest in the politics of Central Asia, and the significance to England of the proceedings of Russia in that region. As Director of the Persian portion of the Government Indo-European Telegraph, I was in constant intercourse with officials of every rank and class, both in the capital and in the provinces. And as this intercourse was generally of the most friendly nature, I had many opportunities of discussing local politics without the restriction of diplomatic reserve.

In the ordinary course of my duties, especially during journeys in almost every part of the country, I could hardly fail to become acquainted with the general sentiments of the community. The Telegraph, being a joint English and Persian Department, and very largely made use of, not only by the Government, but by the general

public of Persia, I had, of course, a practical school in which to learn the characteristics of the people.

I have several times crossed, by different routes, the continent of European Russia, and once passed through the Caucasus. During these journeys, and on other occasions, I have not unfrequently discussed Central Asian affairs with Russian acquaintances, both civil and military. These uninteresting personal matters I mention merely by way of excuse for what may appear my presumption in addressing you.

Before addressing myself to the subject in detail, I would wish to enter a protest against the idea that there is, as between England and Russia hitherto, any international "*Central Asian Question*" at all, inasmuch as I presume that we have never *questioned* the right of Russia to advance in countries over which we had no control, and with which we had no relations. The only question which has actually arisen, is that of the northern frontier of Affghanistan, and this has apparently been settled satisfactorily to both Powers. The important general questions, however, remain much as they did before this settlement, viz.:—In what way, and to what extent, does the gradual advance of Russia in Central Asia affect our position in the East? and secondly, What are the best means at our command of protecting our possessions against any dangers that such an advance may render us liable to?

With regard to the former of these, viz., how the Russian encroachments may affect India, I think we may take it for granted that there is no prospect of their ever enabling Russia to *conquer* India. Even if she were at Cabul at this moment, I believe most competent authorities are of opinion, that any direct attack she might make on India would meet with disastrous defeat. The only practical effect, one certainly of no slight importance, would be the power which her propinquity gave her of disturbing the tranquillity of the vast population of India, and *threatening* our military occupation of the country. This would, of course, necessitate the maintenance of considerable forces at the threatened points of the frontier, and an increase of the general garrison of India. This, it is unnecessary to point out, would bear heavily, perhaps insupportably, on the finances of India, and cripple any military operations we should be simultaneously called upon to make elsewhere. It is, however, evident that, even for a threat, a simple advance to the neighbourhood of our frontier would prove abortive, unless it were tolerably well protected and supported in flanks and in rear. A feint, to be effective, must be capable of development into a real attack. Even the mass of the population of India might be trusted to perceive the precarious position of a Russian force at the end of a long, difficult, single line of communication with its base. And, similarly, Russia may be trusted not to assume a menacing attitude near our frontiers, without fair security against the safety of her advanced corps being compromised. The evil effects of a Russian advance towards India depend, therefore, infinitely more on its *nature* than on its *extent*. A well-based advance should be checked by every means in our power, while the temerity of one of an opposite nature would infallibly lead to its own collapse.

The whole question, therefore, like every other great military opera-

tion, resolves itself into one of communications. A glance at the map will show that, to advance towards India, Russia must base her operations either on the Caspian or the Sea of Aral. Of late years her actual encroachments—at all events those to which public attention has almost exclusively been drawn—have been based on the latter. Her recent acquisitions depend entirely on the line of the rivers and valleys debouching on the Sea of Arai, essentially on the two main ones, the Syr Deria, or Jaxartes, and the Amou Deria, or Oxus. On the former, the power of the Russians is continuously established, and a flanking movement to their right, from Tashkend and Khojend, by the subjugation of Samarcand and Bokhara, has brought them into the valley of the Oxus, above and beyond Khiva. Hence has arisen the necessity of their present expedition against that State. Khojend is, in fact, the geographical limit of any possible approach to India by the valley of the Jaxartes. The possession or control of the whole valley of the Oxus becomes, therefore, of prime importance to any safe advance to the borders of Affghanistan. Even for the security of their hold on the districts of Samarcand and Bokhara, the subjugation of Khiva is essential. It is doubtless owing to the existence of Khiva as an independent and inimical State, on the most direct line from the Sea of Aral to Bokhara, that the latter Khanate has not, although subjugated, been hitherto incorporated with Russian Turkestan. The success of the present expedition will give Russia the same command over the valley of the Oxus that she now has over that of the Jaxartes, and the actual absorption of Khiva and Bokhara will become a mere question of expediency. A further advance up the valley of the Oxus to Badakshan and Wakhan will only then become practicable. With Khiva on the direct line still unsubdued, and Bokhara still unoccupied, the Russian Government could have had no great scruples in accepting, as they have done, our proposals regarding the remote frontiers of Affghanistan. The occasion, therefore, of our opening diplomatic correspondence on the subject appears to have been well chosen.

From the above remarks I think it will be seen that Russia has not yet attained a position from which she can safely threaten even the outworks of our Indian citadel from the base of the Sea of Aral. This base, with its long lines of operation along the Oxus and Jaxartes, it should be remembered, is by no means a good one, as it is very remote from the centres of power, and being effectually closed by the severity of the winter in those regions, can only be available for extended military operations during a portion of the year. Were this, therefore, the only base that Russia could possibly avail herself of in approaching India, I think we might contemplate her encroachments with equanimity, if not with positive satisfaction. The slave-holding, kidnapping, barbarous, and fanatical States of Turkestan are utterly unworthy of sympathy, and Englishmen, at least, may well view with a certain satisfaction the punishment of the murderers of Stoddart and Conolly. Nor is it necessary in this discussion to assume that Russian advances in Turkestan owe their origin to any preconceived plan of attack against ourselves. Their significance to us is totally independent of the motives with which they may have been undertaken.


SKETCH MAP
to illustrate
THE STRATEGY OF RUSSIA
IN
CENTRAL ASIA.
Railways shewn thus
opened
proposed
Roads
Russian Boundary
English Miles
BLACK SEA
CASPIAN SEA
SEA OF ARAL
MEDITERRANEAN SEA
RED SEA
PERSIAN GULF
ARABIAN SEA
Straits of Ormuz
ASIA MINOR
ARMENIA
TRANS-CAUCASIA
MESOPOTAMIA
SYRIA
AZERBIDJAN
PERSIA
TURKESTAN
AFGHANISTAN
BELOOCHISTAN
BADAKSHAN
Carpathian Mts
Balkan Mts
Caucasus Mts
R. Danube
R. Kuban
R. Orontes
R. Tigris
R. Euphrates
R. Kerche
R. Atrek
Tejend R.
Sir Daria (Jaxartes)
Amou Daria (Oxus)
Moorgh-ab R.
L. Van
Odessa
Rostov
Tzaritzine
Astrakhan
Sebastopol
Adrianople
Constantinople
Bosphorus
Dardanelles
Vladi Kavkaz
Petrovsk
Poti
Tiflis
Bakou
Kars
Erivan
Erzrum
Kharput
Tabreez
Antioch
Aleppo
Mosul
Anah
Bagdad
Basra
Port Said
Suez Canal
Kirmanshah
Teheran
Resht
Ispahan
Shuster
Shiraz
Bushire
Bunder Abbas
Chikishlar
Ashurada (Russian Station)
Astrabad
Khiva
Bokhara
Samarcand
Tashkend
Chemkend
Khojend
Kokand
Merv
Meshed
Herat
Cabul
Peshawur
Candahar
Kelat
Bunpore
Kurrachi
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It is chiefly owing to a conviction that, by way of the Sea of Aral *alone*, Russia can never hope to make even a diversion against India, that I have been induced to offer these remarks on the subject, in the hope of recalling public attention from an *accessory* to the *real* cause of apprehension. The Press, not only of England, but I may say of Europe, has of late been filled with articles on the past and projected successes of Russia in Turkestan and their influence on our Indian Empire, the views expressed being optimist or pessimist according to the bias or temperament of the writers. And this public discussion, I cannot help thinking, has been greatly fostered by the Russians themselves. It is not the usual practice of their journals to discuss pending negociations, as in the recent question of the frontier of Affghanistan. Their object, I imagine, may have been to draw marked attention to proceedings in Turkestan, which could not be concealed, and to lead England to persist in asking for what they had already made up their minds to concede. This concession, they might hope, would bring the discussion to a graceful close, and lull for a time the watchfulness of England. My idea, however, may be erroneous, and it is perhaps somewhat beside the point.

The real importance of the Russian advances from the Sea of Aral lies, in my opinion, in their relation to the great base of the Caspian from which public attention has been too much withdrawn. It may therefore be appropriate to examine for a little the resources Russia already possesses on that sea, and the projected measures by which she will multiply them.

Her great line of communication with the Caspian is the Volga, a noble river, navigable for steamers from its mouth to Tver, between St. Petersburg and Moscow, a distance of somewhere about 1,000 miles. One of its tributaries, the Kama, is also navigable to Perm on the highway to Siberia. The Oka, which joins the Volga at Nijni Novgorod, is also navigable for a great distance. Three great railways, connected with the general railway system of the Empire, already lead to the Volga at Nijni Novgorod, Saratov, and Tsaritzin, from which last another short line leads to a point on the Don, which is thence navigable to the Sea of Azov. There are three flourishing companies on the Volga, the *Kavkaz e Mercurij*, the *Samolet*, and the *Volga*, each with a numerous fleet of excellent fast steamers, besides an immense number of barges and steam tugs. The river is peculiarly free from obstructions to the navigation. I have twice gone by steamer from Astrakhan to Nijni Novgorod, and once from Astrakhan to Tsaritzin, during all of which voyages I observed that we hardly ever even slackened speed throughout the night, and this in the Autumn, when the nights were long and the water at its lowest. Passenger steamers ascend from Astrakhan to Nijni Novgorod, a distance of 800 miles, in eight days, and descend in six, including stoppages at all the principal towns on the banks. Saratov is about half-way, and Tsaritzin is within 30 hours' steaming of Astrakhan. Here I may casually mention, as an illustration of the vast changes which railways have made in Russia since the Crimean War, that I once left Astrakhan on a Monday forenoon and arrived in Berlin the following Monday

morning. At Astrakhan there is a well appointed Naval Arsenal, leased by Government to one of the steamer companies.

The disadvantages of the Volga are, the bar at its mouth, and the closing of all navigation by ice for about six months of the year. The bar is usually passed in flat-bottomed barges hauled by tugs, the Caspian steamers anchoring outside at what is called the "Nine Foot." These vessels, however, are all of slight draught, and can be so lightened as to pass the bar without difficulty, especially during southerly winds when the water is deeper.

The great defect of closed navigation in winter is now in course of remedy by means of railways to ports on the Caspian that are always open throughout the year. Last year, a line was opened from Poti, on the Black Sea, to Tiflis, the capital of the Caucasus, whence it was intended to continue it to Baku, an excellent port on the Caspian. Mainly through the exertions of the late General Kouloubakine, Governor of Baku, that port has, within the last few years, been greatly improved. Quays have been built, with jetties alongside of which the steamers can be laid. Fresh water has also been brought down in pipes to the water's edge. An inexhaustible supply of gas, the source of the famous natural fires of Baku, exhales from the naphtha springs in the neighbourhood, and the naphtha itself is used in place of other fuel in the Arsenal of Astrakhan. Baku, a corruption of the original Persian name, Badkubeh, has a naval arsenal a short distance from the town, and is the residence of a military governor and of the Admiral Commanding the Caspian Fleet.

I understand that the railway from Tiflis to Baku is now in abeyance, and another line adopted from Rostov, at the mouth of the Don, the terminus of the present railway system, to Petrovsk, a good artificial harbour on the North side of the great range of the Caucasus. This decision has probably been come to on account of the somewhat exposed position of the Poti-Baku line in case of a war with Turkey. Its ultimate construction, although now postponed, is, however, only a matter of time, as the most formidable physical difficulties have already been overcome on the section from Poti to Tiflis. Even should the Baku line be finally abandoned, Tiflis will have excellent communication with the railway to Petrovsk by the magnificent road over the range of the Caucasus through the pass of Vladi Kavkaz. In a few years, therefore, we may expect to see Petrovsk and Baku, which are both open throughout the winter, in direct railway communication with the Black Sea and Russia generally.

And here I may note the significance, as regards Central Asia, of the recent modification of the Treaty of Paris, which restricted the freedom of Russia in the Black Sea. The northern and eastern shores, besides being interrupted by the Straits of Yenikaleh and the Sea of Azov, are physically ill adapted for good communications by land between Odessa, the Crimea, and the Caucasus. A naval force on the Black Sea becomes, therefore, a not unimportant part of the chain of communication between the South of Russia and the Caspian.

Russia has, therefore, or rather will soon have, the means of sure and rapid concentration of a force on the western shores of the Caspian,

at favourable ports which are always open. This force she has also the means of transporting by existing steamers, without the slightest opposition, to any point of the eastern shore, Persia being precluded by the Treaty of Turkomantschai from the right, even if she had the power, of floating a single gun on that sea.

The country on the East of the Caspian, between the sea and the valley of the Oxus, is for the most part perfectly desert, although inhabited here and there by independent tribes of nomadic Turkomans, whose chief occupations have long been robbery and piracy. The north-eastern frontier of Persia, between Asterabad and Meshed, is perpetually subject to their raids, Asterabad itself narrowly escaping capture in 1867. The prisoners made in their forays are either held to ransom or sold as slaves to the Oosbegs of Khiva and Bokhara. These markets will soon be closed to them by the Russians, and they will perforce be led to follow more peaceful lives. Ostensibly, and no doubt really to some extent, for the suppression of Turkoman piracy, the Russians keep up a considerable naval station at Ashuradeh, a small island in the bay of Asterabad, at the south-east corner of the Caspian.

This island, where I spent a few days in 1868, and which I again visited in 1871, is entirely of loose sand barely rising above the water. It almost touches the peninsula of Potemkin on the west, and a long spit runs out from it to the eastward, forming a perfect natural breakwater, behind which there is excellent anchorage for any number of vessels. On the mainland of Persia, opposite Ashuradeh, the Kavkaz e Mercurij Steam Navigation Company have an agency, a landing wharf, cargo hulks, &c. There are usually three or four men-of-war stationed at Ashuradeh, besides a few others cruising in the neighbourhood, the whole under the command of a Commodore, who, with many of the officers and men and their families, lives on the island. Supplies of provisions and fuel are chiefly derived from the neighbouring Turkomans, towards whom the Commodore, in addition to his strictly naval duties, acts in the capacity of a Political Agent. Every Turkoman boat is at once seized if found unprovided with a passport from the Commodore. By this system, the whole of the independent coast on the east of the Caspian is practically under his control. In close relation with him, and under the orders of the Russian Minister at Teheran, there is a Consulate at Asterabad, the capital of the Persian border province of the same name. There is an English Consul at Resht, but none at Asterabad. The Russian Diplomatic and Consular Corps in the East form, it may here be noted, one Service, under a special Eastern Department of the Foreign Office at St. Petersburgh.

I had no opportunity of seeing any Russian posts on the Turkoman mainland in this neighbourhood, but enough has been said to show that the Russians possess ample means of establishing and maintaining a *pied à terre* wherever they please. This they appear to have done near the mouth of the Attrek valley, and also between it and the Gurgàn. With this and the fall of Khiva, the Turkomans will become isolated by the Russians, who will then have little difficulty in reducing them to a state of vassalage. Their excellent breed of horses, remark-

able not only for their size and strength but for their endurance, will then be available to the Russians for military purposes.

From this point, Tschikishlar and the neighbourhood, the Russians may push up the valley of the Attrek (which, by the way, is not navigable) clear of Persian territory, although close to it, to Merv, a point of great importance, whence they might establish a line of communication with their possessions on the Oxus. Although now desolate, Merv is still capable of its former opulence, and I have little doubt of its being the ultimate aim of the present concentration opposite Ashuradeh. The very desolation of Merv will facilitate the establishment of a Cossack colony around it, which will then become the key of the whole Russian system in Central Asia. I see no way in which this can be prevented; and we must contemplate the fact that, in a short time, Russia will be firmly established in this central and commanding position, with communications resting both on the Caspian and the Sea of Aral. This is the clear prospect, in my opinion, before us. We should, therefore, look it steadily in the face, and not allow the dust of Badakhshan and Khiva to be thrown in our eyes. Issuing from Merv, and still rounding the frontier of Persia, a Russian force might push up the valley of the Moorghab into Affghanistan, seize Herat, and advance by the great highway of Candahar to the borders of India.

Such an operation, however, it is manifest by a glance at the map, can only be practicable with the *connivance of Persia*. The more direct line through Meshed would, of course, involve her actual alliance. And herein lies, in my humble opinion, the kernel of the whole question. *With* Persian assistance, Russia can attack Affghanistan in force by way of Herat on the West, while she makes a simultaneous demonstration from the Oxus on the North. *Without* Persian connivance, such an enterprise would be hazardous, if not desperate.

For any undertaking of this kind, Russia's recent and projected operations in Turkestan are of strategical importance, as *they clear her left flank* in the advance from the Caspian to Affghanistan, and provide her with a *subsidiary* base of operations on the Sea of Aral. The latter alone, as we have already seen, is in itself of slight importance, but, taken in connection with the former, is of great significance. An advance from the Caspian, which is the only line, in my opinion, by which Russia can ever seriously threaten India, would be impossible with an independent Turkestan on one flank and Persia on the other. She is now engaged in absorbing Turkestan, and thereby securing her left flank—an operation in which we have no power to interfere, and regarding which it is futile to complain. As I said before, it is unnecessary to assume that the operation is undertaken against ourselves, but the result is the same.

It therefore becomes us to say as little as possible regarding *that* flank of the possible attack on which we have no means of interfering, and rather to turn our attention to, and keep it steadily fixed upon, the *other* flank, where, it must be hoped, all our power to influence events has not passed away. With Persia on our side in flank, and Affghanistan and our own force in front, the attack would probably never be

attempted, or, if attempted, would only lead to disaster. *On Persia therefore, we must fix our constant attention;* and no pains should be spared on our part to prevent her throwing her weight into the scale against us.

Fortunately for us, Persian interests and our own are identical, as it is clearly to our interest that Persia should be strong and independent. The more powerful she becomes, the more she will lean to our policy in the East, and the weaker she is, the more will she be apt to play the catspaw to her big neighbour. The *conquest* of Persia will be too arduous an undertaking for Russia to attempt for many a long year to come, although by menaces and partial occupations she may induce Persia, on critical occasions, to take her side. The thirty years' struggle with an insignificant race like the Circassians taxed all the energies of the Russian Army. Huge as the military force of Russia is, and unequalled in its power of resistance, it has no proportionate capability of attack. Its organization is by no means perfect, the great bulk of the junior officers are poorly educated, and the Russian peasant of the ranks is individually inferior to the Persian rayat. With an improved organization of her Army, and a growing confidence in her own powers of resistance, Persia would feel more inclined than she would otherwise be to withstand the menaces of Russia, and adopt an independent and therefore English policy. Besides all this, Russia must be well aware that a war with Persia would at once set her own new Mussulman possessions in Turkestan in a flame, and Persians have acuteness enough to perceive this.

A golden opportunity of improving the Persian Army and adding to our own influence in the country was lost, three years ago, when the Shah's Government, of their own accord, asked for the services of English officers to aid in drilling and organizing their troops. For some reason, but why I do not know, this request, although I believe entertained, was allowed to drop. However it happened, the result is unfortunate, as we lost a chance of really serving Persia, and thereby advancing our own interests, without giving cause of umbrage even to Russia. Should such another opportunity present itself, it should not again be let slip. The presence of a few able officers in the Persian Army would do wonders now, as they did before, in the earlier part of this century. The Persian soldiers are perhaps superior in physique to any in the world, and the whole nation is peculiarly active, both in mind and body. They are born horsemen, and the country abounds in excellent horses. Even the highest personages, so unlike in this respect to most other Orientals, think nothing of riding post at the rate of 80 or 100 miles a day. I remember, for instance, the present Prime Minister, when Ambassador at Constantinople, proceeding in this fashion to his post from Teheran by Baghdad and Diarbekr, a ride of 1,500 miles. With irregular Cavalry ready to hand, and admirable material in the way of men for the other arms of the service, a proper organization and good modern armament are alone wanted to render a Persian Army able to cope, on its own ground, with any expeditionary force from Russia.

As regards the feeling throughout the country, I should say from

experience that it is, on the whole, friendly to England and hostile to Russia, the influence of the latter being confined to the capital and the shores of the Caspian. The establishment of the Telegraph, worked by an English staff, has, I am convinced, greatly tended to a *rapprochement* between Persia and England, and the presence of a number of properly qualified English officers with the Persian Army would undoubtedly tend still more in the same direction. Our first appearance in the country in 1863 was viewed with suspicion, which gradually gave place to indifference, and finally to general approval. Any joint operation of Russia and Persia, especially if it involved the presence of a Russian force in any part of the country, would be intensely distasteful to every class of the community.

Owing to the prevalence of such feelings, I should, as a special measure affecting the question under discussion, recommend the *strengthening of the fortifications of Meshed*, which, it will be seen by the map, occupies a commanding position on the road to India. It is at once the capital of Khorassan and the holiest city of Persia, and thousands of pilgrims annually flock to the shrine, within its walls, of the Imam Reza. A visit to this shrine confers on the pilgrim for ever afterwards the highly prized appellation of *Meshedi*, as the *Haj* to Mecca does that of *Hajji*. The religious feelings of the inhabitants of Meshed, and in fact of the whole country, would be roused against any occupation of the holy city by the infidel, so that we might trust fanaticism to hold it to the last extremity; and its distance from the Russian resources on the Caspian would render a siege a most arduous undertaking. Asterabad is too approachable from the sea to make its fortification advisable. The Ameer of Cabul might also perhaps be recommended to strengthen as much as possible the fortifications of Herat, although on this point I speak with less confidence. Were Meshed and Herat (held as they would be by different States) both fortified and garrisoned so as to resist any attack other than by regular siege, a great stumbling-block would be placed in the way of a Russian advance from the Caspian towards India.

Another measure affecting Persia, and the question under discussion, would be the permanent increase of our naval force in the Persian Gulf, which has unduly dwindled down since the abolition of the Indian Navy.

Before leaving the subject of Persia, I would draw attention to the approaching visit of the Shah to Europe. His Majesty will be accompanied by many of the principal personages of the Kingdom. Russia will be the first country visited, and the Russians will probably not fail to produce an impression on him by an imposing military display. During his stay in England, our own light should not be put under a bushel, and it is to be hoped that every endeavour will be made to give him and his attendants the means of appreciating our own resources. However brilliant the military display with which he will probably be greeted in Russia, he will hardly fail to notice the generally poor appearance of the country, and its marked contrast in this respect with England.

A concession has been lately granted by the Persian Government,

for a railway from Resht on the Caspian, to Teheran, and thence to some point not yet determined on the Persian Gulf. If this railway is ever finished, it will be of great benefit to the country, as a means of saving it from the horrors of another famine. I hardly see, however, how it can greatly affect the strategical question under discussion. If one terminus is of easy approach from Russia, the other will be nearly equally so from India.

I shall not enter upon the large question of the Euphrates Valley Railway. The establishment of such a line of communication with India would provide a most valuable alternative to that by the Suez Canal, which might be *effectually closed in an hour or two when we needed it most.* It would, also, no doubt, indirectly add to our influence in Persia, but otherwise the question is hardly pertinent to the present discussion.

If I say little regarding Affghanistan, it is only from my want of any special knowledge of its affairs. Its position is essentially different from that of Persia, inasmuch as it must always lie, not in flank, but in the direct front of any Russian advance, and is moreover at our own doors. The policy of the Government of India, as manifested on the occasion of the late lamented Viceroy's great Durbar at Umballa, appears to have been thoroughly successful. Difficulties will no doubt arise through intestine feuds on the death of the present and future Ameers of Cabul, which must be dealt with as they come. But the general policy may still be adhered to of assisting the Ameer (*de facto* or *de jure* as the case may be) to establish his authority, and promising aid in case of invasion, without entrammelling ourselves by any more definite treaties. Such a policy has already made an ally of the present Ameer, and may be expected to have the same effect with future ones. Above all, I would deprecate any rectification of our own borders, even for the gain of a better military position, which would cause the slightest suspicion of our good faith. Even should Persia be overawed, against her better judgment, into turning against us, it is almost incredible that Affghanistan should ever be led to follow her example, our interests being so clearly identical. Moreover, should Persia, at any time, show signs of wavering, direct pressure may be brought to bear against her through Affghanistan. And she may be led to see, independently of her true interests pointing in the same direction, that Affghanistan, backed by India, is quite as formidable a neighbour as Russia. It is important, therefore, that our dealings with both those Asiatic States should *hang together*, so to speak, and be interdependent on each other.

As affecting both those countries, I may add a word regarding their boundaries. The recent definition, by the mission of Sir Frederick Goldsmid, of certain long disputed portions of the eastern frontier of Persia, must be productive of many advantages to Persia, Affghanistan, and Beloochistan, and collaterally to ourselves. With an undefined and disputed boundary there was a perpetual source of danger to the peace of those countries, and more remotely of India. If any portion of the frontier is still indefinite, measures should be taken, in concert with Persia and Affghanistan, for its speedy settlement. The work of

the joint Commission for the settlement of the Western frontier of Persia, although interrupted by the Crimean War, and still I imagine unfinished, has doubtlessly on several occasions saved Turkey and Persia from hostilities. With a similarly definite boundary on the East, one perpetual incentive to encroachment on either side will cease, and we shall hear no more of Persian aggressiveness at the instigation of Russia. At peace with each other, both Persia and Affghanistan may securely turn their attention to internal improvement and consolidation. Instead of wasting their energies against each other, and continually producing uneasiness in India, they may be induced to make common cause against any assault on their independence from the North.

In conclusion, I need hardly say that too much reliance must not be placed either on Persia or Affghanistan, although no opportunity should be lost of influencing their policy in our favour. So long as they are independent they will prove most valuable outworks to our Indian fortress, and must fall into the power of the enemy before the *place* itself can be assailed. And the stronger we can make them, the more are they likely to retain their independence, and stem the tide of Russian aggression. *But our final and only trustworthy stay must be our own military power in India.* How, should the actual tide of invasion ever reach our borders, we can best roll it back, and what steps to that end should in the meantime be taken *within* our own frontiers, I leave to more competent individuals than myself to indicate.

It has recently been said, and said truly, that the shadow of our power falls far beyond the snowy barrier of the Hindoo Koosh. If I may be allowed to adopt the metaphor I would add, that care must be had that the Northern Light, whose rays are beginning to penetrate the penumbra, should not, by increasing brilliancy, pale our own luminary, and thereby cast the shadows of the barrier in an opposite direction.

Major Burne: I am sure we must all thank Captain Murdoch Smith for his valuable lecture, and more especially, because he has, to a great extent, called attention to the chief weak points of our position in India. I agree with what he said, at the beginning of his lecture, that everybody who has the slightest knowledge of the subject ought, on all possible occasions, to come forward and contribute what little he knows, which must be my excuse for entering into the present discussion. As regards Badakshan, Major Smith is quite right when he says we must not let the settlement of that portion of frontier blind us to greater dangers to the south-west, but, at the same time, we must, in fairness, give it its true value, which is this:—the Russians have been long moving in that direction; they have taken Kuldja to the east, and have concluded a commercial treaty with Yarkand. Badakshan itself is only 120 miles distant from Peshawur. Therefore, in settling the northern boundary of Badakshan, we have no doubt done a wise thing, because the access from that part of the world to India is almost as easy as by way of Persia. We have a great mass of mountains between us, it is true, but some of the passes are only 5,000 feet high, and a hostile Army can, without impediment, reach Cashmere, at any season, when the passes between us and that territory are covered with snow, and inaccessible to us. So that, this fact alone gives that part of the country a great value to us, which we must duly appreciate in discussing the Central Asian

question. In settling the boundaries of Badakshan, and including it in Afghan territory, we have done a thing for which the Ameer of Cabul is extremely grateful to us. We have, if possible, made him much more dependent and reliant upon us than he was two or three years ago, and we have increased our influence with him, which is a great point gained. I am one of those who agree, most strongly, with the fact that we have no means of resisting Russia taking Khiva or Bokhara, and that, therefore, it is better not to entangle ourselves by trying to prevent her; but, at the same time, we must be very careful not to lend any countenance to her in conquering those countries. It is all very well for people to say that Russia spreads peace and Christianity, but facts tell us that she spreads war and devastation. We must, therefore, be most careful not to give Russia the slightest countenance in her unlawful conquests, for she is trying to disseminate the idea that we are going hand in hand with her, in her policy of annexation; an idea which materially assists her plans and paralyzes resistance. Major Smith has done great service by drawing our attention to the north-western part of the country. He has mentioned the occupation of the Valley of the Attrek, which is a great blow to us. Russia has long harboured designs in that direction. So far back as about 1725, she acquired Asterabad by a treaty with Persia, which, I believe, has never been cancelled, and she may therefore, on this pretext, take it whenever it suits her to do so. But, in looking at these dangers, we must, as Major Murdoch Smith said, rely on ourselves. If we acknowledge that we have no means of resisting Russia annexing these distant countries, then the only counter-move we can make is to strengthen ourselves, and the best way to do so is, as the late Viceroy so invariably demonstrated, to surround ourselves with independent States, such as Yarkand, Afghanistan, and Beloochistan, and to make them strong, friendly, and one with ourselves. This is our best protection against this advance of Russia. As regards what Major Murdoch Smith says, in respect to British Officers being sent to drill the Persian Army, I may explain that the proposition was made three years ago, but, at that time, Persia was not only attacking Afghanistan, but Beloochistan—both our allies—so that the proposal to help her with British Officers, in her encroachments towards India, could hardly be entertained. You know, also, that when we last sent British Officers to Persia, to train her Army, we became entangled in the siege of Herat, which was contrary to our whole policy, and obliged us to withdraw our Officers. Naturally, therefore, three years ago, when Persia was encroaching on Afghanistan and Beloochistan, we declined to send her British Officers to teach her how to do it. Since that time, under the able management of Sir Frederick Goldsmid, we have drawn a direct line of frontier between Persia and our allies, from the coast up to Herat. Now that is done, let us send Persia Officers, by all means, provided she adheres to this changed and peaceful policy. Major Murdoch Smith has drawn attention to Merve, which is, no doubt, an important point. Russia sent a reconnoitering detachment of men there more than a year ago to survey and report upon the place, and she has also established an Agent, according to reliable reports, at Meshed, with a view to keep an eye on Merve. I concur with Sir Henry Green, and others, in thinking that our weak point is, in reality, Seistan, which is south of Herat, and has plain, good roads, where troops can move easily and gain easy access into India; not by the difficult passes on the north, but by the easier passes of the south. Therefore, I am one of those who, in the present aspect of affairs, think we should occupy some strong, defensive post in Beloochistan, to show our friends and enemies that we will not stand any nonsense. Carrying this out, with the consent of Afghanistan and Khelat, we could effect a quiet demonstration, which would have the greatest effect throughout the whole of Central Asia, and on none more than on Russia, Afghanistan, and Persia, against the whole of whom we must protect ourselves, because we cannot really trust any of them. Again, we must not forget the Persian Gulf. It is not only to Badakshan or the Attrek, but to the whole circle of our defences, that we must look. Turkey has obtained a footing in Arabia, and floats several men-of-war in the Persian Gulf. We must, therefore, be careful in our relations with Constantinople, and indeed, by strong and proper diplomacy, take every means of preventing any attack, on the part of Turkey, Persia, Russia, or any other power, at a time when we may be in difficulties. By attending to this essential point, and surrounding ourselves with the strong and friendly States which

the late lamented Viceroy so wisely advocated and established, we shall ensure a moral strength and prestige, both in and out of India, which will be a real protection in the hour of need.

Col. Sir Frederick Goldsmid: I fear I have but little to say on the present occasion. As, however, you have been kind enough to call upon me, I may express general concurrence in what Major Murdoch Smith has stated. We might, in detail, differ on certain points, but no more. As regards our position in India, my own opinion is, that as we have now defined a frontier beyond our own frontier, we may consider ourselves secure, so long as there is no infraction of this outer line. That is to say, we have come to an understanding with Russia on the north east frontier of Afghanistan and up to the Perso-Afghan frontier west of Herat (there may be objection to the understanding, but none, I think, to the actual boundary); and by a separate negotiation with Persia and neighbouring States, with which I myself have had something to do, the line thus determined has been continued, more or less, from below Herat down to the sea, so as to form a perfect *cordon*. If that boundary were infringed from the westward, or if infraction were likely, then, I believe, it would be well to consider the question of pushing on in advance of our present Indian outposts, not otherwise. I would explain my *cordon* to be the line commencing in the north-east of Afghanistan, at the Sari Kul, carried on to the junction of the Kokcha and Oxus, and along the Oxus to Khoja Saleh; thence in a south-westerly direction to the frontier west of Herat, and south through Seistan and Beloochistan to the Mekran coast. In other words it is the whole eastern frontier of Persia. The question of Persia itself is a serious one, and I quite agree that if we could trust thoroughly to her as an ally, such an alliance would perhaps be the very best we could have at the present time, because Persia is no doubt a very important country situated between India and Russia. But unfortunately in Persia, the Government is not the country. The three or four individuals who now represent the Government, are aiming at advanced civilization, and consequently glad to be on the best of terms with all the European States. These men may go out of power to-morrow, and another party may come in; this may be the party of the priesthood, and it may be perfectly hostile to us and to all European nations; so that I do not think we can thoroughly depend upon an alliance with Persia as a safe or lasting measure. It is an alliance rather with a few individuals who constitute the new school of Persia. I do not mean to say that we should disregard the friendship of that country, or fail to strengthen it in every legitimate way: quite the reverse. But we must not place too much dependence upon it. Nor do I think, in spite of our own prestige in the East, that we can always say we have a superior influence to Russia in Persia. I am afraid I cannot quite subscribe to that somewhat prevalent opinion. We have, it is true, every now and then our chance, and we can go up while Russia goes down, but it is *vice versâ* occasionally. At the present moment I do not think that we have less influence than Russia, but neither can we say that ours is markedly superior to hers, or indeed to that of other European States with which Persia has relations. France, unfortunately at the present moment, is not in a position to exercise much influence there, nor do I suppose she will do so for a very long time, and therefore it is really only Russia and ourselves that have any material interest in the matter. Let us suppose for a moment Persia completely in the hands of Russia, and England unpopular there, Persia might advance Russian troops to within 400 miles of Kurrachee. There is a place called Peshin on the newly determined frontier whence opens out the valley of Kedje leading to Beylah. East of that valley a difficult mountain pass presents itself, but if once traversed, the whole country is open to Kurrachee. Attention to this route has always appeared to me important. Distances are undeniably great, and there are many physical obstacles to troops marching in Eastern Persia, but if you have a friendly people to aid, there is no reason why they could not pass Russian troops as well as their own. I really came quite unprepared for speaking, but, as I said at first, I think the *cordon* described, is about our best present guarantee for India; and if Persia, Afghanistan, and Beloochistan keep to that limit, we need not feel much anxiety at the movements in Western Turkestan.

Captain J. F. F. Cologan, B.S.C.: There is one point I should wish to draw attention to. A reference has been made about assisting our allies so as to strengthen their power

to form a barrier outside of India. The Ameer of Afghanistan at one time asked for the assistance of British Officers to help in organizing his army. The men are about as fine a material as you would wish to come across, and, although at times a little turbulent, are easily managed by British Officers, whenever they get them in the ranks of our Native troops. I think this request of the Ameer might be conceded, but at the same time there is always a certain risk. British Officers going to Afghanistan render themselves liable to be at any time assassinated by the fanaticism of some people who do not view them in a favourable light. But, notwithstanding that it would be a service of danger, I am certain that British Officers will always be ready to come forward and undertake a duty of this nature, and I feel sure that the Afghans officered by British Officers, would always be able to encounter and repulse Russian troops in the fortresses which we see so marked all round the frontier of the country.

Major Knollys: Major Murdoch Smith has pointed out very ably the strategical importance of Persia in the Central Asian Question. It is a truism to say that the whole question is one of communications. Major Smith recognizes that fact up to a certain point; he has told us about the communications across the Caspian and down the Volga, and by railway to Baku and Petrovsk. But what I think we had not full information about is the communications, possible up the valley of the Attrek, which valley appears as far as we can judge to open, or to lead, into the country bordering on the oasis of Merv, to which attention has been drawn as being a most important point on the way to Herat. What I think we should be glad to know would be, what the nature of the Valley of the Attrek is, what the resources in the way of food are up the River Attrek and along the country on each bank; and also where precisely the frontier of Persia terminates, because there has evidently been a very great amount of uncertainty on that subject, whether the Attrek bounds it, or whether the frontier lies between the Attrek and the Goorgan (see Map); and where the Attrek takes its rise. Also if any one can give any recent information with regard to the navigability of the Amou Deria, it will be a very valuable contribution to this discussion.

Major O'B. C. St. John, R.E.: The gentleman who last spoke has asked for information regarding the valley of the Attrek. I have made a special study of that country lately, although I have never had the advantage of being there, and I may tell you that the Attrek is not navigable. There is a good military road to the north, quite clear of the Attrek, through a country called the Dāman-i-koh, or skirt of the hills, in Persian, and the Attak, in Turkish, which, I think, means the same. This road follows these hills to a point where the Tejend River, which flows from the south-east, loses itself in a swamp, called by the same name. From this point, there is a road, with some two or three days of desert, to Merv. Merv is a ruined town in an oasis on the banks of the River Murgh-ab, which, about this part, is divided into a number of canals, which lose themselves in the desert, about a day's march to the north. The Turcomans have a strongly intrenched camp at this point. The Persian Governor of Khorassan, an uncle of the King, marched from Meshed, in 1859, to Merv, meeting with very little opposition, and partly by force of arms and partly by conciliation, reduced the neighbouring Turcomans to complete submission. He requested leave of the Shah to advance to Khiva, or to Bokhara, but met with an unfavourable answer, and, after some three or four months' occupation, was obliged to withdraw, and was, on his return, deprived of the Government of Khorassan. However, from his representations, the Shah made up his mind to try again, and sent another uncle of his own to Khorassan, as Governor, who, in the following April, moved out a force of some 25,000 or 30,000 men and 30 or 40 guns, to Merv, which he occupied without opposition. After remaining there three or four months, the Persian Army advanced to attack the intrenched camp of the Tekē Turcomans, but, by gross mismanagement, themselves sustained an overwhelming defeat. Strange to say, instead of falling back on Meshed, they retreated in the direction of Herat, along the valley of the Murgh-ab, which shows that there is a practicable military road in that direction. The fugitives of the Army were met by Colonel Pelly, then on his way from Teheran to India, and he brought some of the wounded men into Herat, and had them cared for. That shows that there is a practicable road north of the Attrek to Merv, and east of the Persian frontier, from thence to Herat. That is to say, the Russians have it in their power now, without in the least infringing the

guarantee that they have given for the inviolability of Persian territory, to take Merv, and not only Merv, but Herat almost before our Minister at Teheran knows anything about it at all. (The CHAIRMAN : Do I understand that road is north of the boundary we see there ?) Quite so. The present frontier of Persia is, no doubt, the Attrek. In spite of all the denials in the papers, there is no doubt, I think, that about December, 1870, or January, 1871, a distinct understanding was come to, between the Persian and Russian Governments, that the Attrek was, in future, to be considered as the Persian boundary. Previously, the Russians had considered either the Goorgan or a river a little to the south, the Kara-su, as the Persian frontier ; the Persians, on the contrary, asserted their claim up to Khiva ; so that the Attrek frontier was a compromise, and has left the best military road open to Russia.

The CHAIRMAN : The lecture, and also the discussion that has followed, have been extremely interesting. We have now only to give our best thanks to Major Murdoch Smith, for his kindness in coming here to address us.

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Evening Meeting.

Monday, February 17th, 1873.

VICE-ADMIRAL A. P. RYDER in the Chair.

NAMES of MEMBERS who joined the Institution between the 4th and the 17th February, 1873.

LIFE.

Robertson-Ross, P., Colonel, Adjut.-Gen. of Militia, Canada.
Herbert, Ivor J. C., Lieut. Gren. Guards.
McHardy, Wallace B., Commander, R.N.

ANNUAL.

Barton, Robert, Captain, R.E.
Carson, James S., Captain Royal Bucks K.O. Militia.
Couchman, E. H., Colonel R.A.
Whitaker, Geo. T., Lieut. 60th Rifles.
Hubbard, A. G., Lieut. 3rd Bucks Rifle Volunteers.
Morshead, A. A., Lieut. 24th Regiment.
Protheroe, M., Capt. Madras Staff Corps.
Mitchell, Hugh H., Lieut. Rifle Brigade.
Farrington, H. D'O., Capt. 73rd Regt.
Stallard, William, Captain 1st Worcester Artillery Volunteers.
Blake, A. M., Lieut. Gren. Guards.
Rowsell, F. W., Esq., Superintendent of Admiralty Contracts.
Wilson, J. C., Captain R.N.
Liebenrood, John, Captain R.N.
Dobbing, Frederic, Ens. 20th Middlesex Rifle Volunteers.
Seymour, Lord Albert C., Lieut. Scots Fusilier Guards.
Lugard, E. J., Lieut. 4th King's Own Royal.
Reidhaven, J. C., Viscount, Lieut. 1st Life Guards.
Malgarini, Fred. L., Lieut. Forfar and Kincardine Artillery Militia.
McLeod, W. C., General.
Brine, Lindesay, Captain R.N.
White, F. B. P., Captain 1st West India Regiment.
Cardew, Frederick, Capt. 82nd Regt.

FLEET EVOLUTIONS AND NAVAL TACTICS.

By Commander CYPRIAN A. G. BRIDGE, R.N.

ADMIRAL RYDER AND GENTLEMEN—

By invitation of the Council of our Institution, I have come here this evening to read a paper on a subject which I believe to be most important. Unhappily it has by no means attracted the attention which, as a matter so closely concerning the efficiency of the Navy, it justly merits. I must, at the very outset, confess my own inability to add much to your knowledge of it; but I hope some good may result from my venturing to bring it under your notice. Though there are not wanting Officers who have bestowed upon NAVAL TACTICS much thought and patient study; still, it cannot be denied, that the consideration of

the art, has not occupied the minds of the great body of Naval Officers in general. I hope that the study of it will soon become the common pursuit of the many, rather than, as now, the special occupation of the few. I may remind you how you yourself, Sir (who first turned my own thoughts in its direction), gave it, years ago, an ample share of your consideration; and I may also select from the short list of students of tactics the names of Captain Goodenough, Commander William Dawson, and Commander Fisher. Here, in this theatre, on more than one occasion, and in those official labours of his, which will long leave their mark upon the Service, has Captain Colomb employed his talents as a lecturer, and his graceful pen in endeavouring to teach us, his brother Officers, that which, I fear, too many of us have been but slow to learn. These names do not of course exhaust the list of those who have studied the art of modern NAVAL TACTICS; but they are the names of those with whose labours I am personally familiar, and to whom, I gratefully acknowledge, I am under no small obligation.

I have given to this paper a two-fold title, because I shall try to point out in it the distinction between the evolutionary and the tactical manœuvres of fleets; and also the connection existing between them. The former are the bases and foundations of the latter; the indispensable preliminaries without which tactics could scarcely be devised, or, even if devised, employed with advantage. "Those who know any-"thing of the Navy," says our oldest authority, the Jesuit, Hoste, "will not doubt that the *art of Naval evolutions* is absolutely necessary "to it; since that art is nothing else than the manner of regulating all "the movements of a fleet. Without it, a fleet resembles a force of "savages, who do without order, all that caprice inspires, or chance "suggests. Without it an Admiral can make only very imperfect use "of his fleet, whether it be to oppose the enemy in the proper way, or "to cut his line, double on him, avoid him, bring him to action, or chase "him; for all these things require that the Admiral should be the mov-"ing spirit of his fleet as the mind is of the various members of the "body." "If," says Admiral Gregory Boutakov, "*only three ships* have "to sail in company, they must have rules based upon the laws of their "own movements, and the knowledge of these same laws is undoubtedly "necessary to each ship even though she manœuvre alone." Sir Charles Ekins mentions Lord Howe and Lord St. Vincent as among "the few British Admirals who, in former days, took any particular "pleasure in exercising the fleet in the different evolutions:" with what result let "the glorious first of June," and the 14th of February, 1797, testify. It is by frequent practice in evolutionary movements, that we are enabled to perform tactical manœuvres speedily and well. "*Pide la Tactica Naval*," says the old Spanish writer Mazaredo Salazar, a name not undistinguished in the naval annals of Spain, "*Pide la Tactica Naval un continuo exercicio; porque no bastará saberla* "*para practicarla bien.*" Which I may translate, "The art of Naval "Tactics requires continual evolutionary exercise; for merely knowing "its rules will not suffice in order to practice it correctly."

The great object of FLEET EVOLUTIONS therefore being to lay a

foundation for NAVAL TACTICS, there are not wanting smaller, but by no means unimportant, ones as well. These may be laid down as being to discover—

1st. The capabilities of each ship as a manœuvring unit;

2nd. The possibility of manœuvring or of handling collectively, any aggregation of such units;

3rd. The best formations and movements for navigation, for preparation for battle, and for actual combat; and also, I may add, to give to Officers facility and confidence in handling a squadron by frequent practice of the various movements.

As specimens of the different classes of what are usually considered evolutionary manœuvres, I may instance, as of the first, the "figure of eight evolution," or that which many Officers will remember as having been practised by direction of Admiral Lord Clarence Paget by the ships of the Mediterranean squadron, and which is too well known to need description here. By it, undoubtedly, the handiness and turning power, the comparative value of different angles of helm at different rates of speed, and the time necessary to describe certain arcs of the circle of turning were rendered familiar to the Officers of each ship, and the knowledge thus gained, must have greatly smoothed the difficulties of the general squadron evolutions.

I may next give, as of the second class, such movements as "altering course," "tacking in succession," "changing position of columns," and "changing formations;" all of which had to be first devised and then assiduously practised before the possibility of handling successfully large collections of ships was properly established.

To the third class belong "orders of sailing," "formations" of various kinds, "line of battle," "line ahead;" and also whatever new manœuvres, recent naval invention has rendered necessary.

Not only do I think that repeated exercise in all such evolutions is necessary to give us the power of imparting strength and flexibility to our fleet-formations; but I also feel convinced that it is by such exercise alone, that we can ever hope to discover what manœuvres will be of most advantage to us if we are ever to fight another general action at sea. Therefore I am of opinion that all evolutionary manœuvres should be devised with this object—which includes all that I have hitherto stated—in view, viz., to make our Officers perfect in the art of handling squadrons and single ships, and to discover—what we have not yet hit upon—that which is to take the place of the old "line of battle," now so completely passed away.

For this purpose, I suggest that all fleet-movements be divided into two main divisions—those intended simply for the purpose of training Officers in manœuvring, which might be called "evolutionary;" and those which it is probable we might be called upon to adopt in action, to which we might correctly apply the designation "tactical." The former class could not well be too numerous. I would not give up one evolution in our present admirable signal-book, of the evolutionary portion of which, I am always glad to have an opportunity of expressing my humble admiration. To those who advocate a reduction in the number of movements it contains—and many of those who do so are

worthy of all respect—I would say with Admiral Boutakov, that it is "our duty to exhibit every formation which, it seems possible can be "employed with advantage under the various circumstances, leaving "to the Admirals—according to the degree of instruction and prac- "tice of their subordinates—to select those which seem to them most "fitting, and to omit those which may appear to them superfluous."

If such a division of our evolutionary scheme be made, we may then conduct the exercises of our squadrons on a systematic plan. We may begin with what is simple and elementary, and, through the various stages of instruction, go up to what is more complicated and more difficult. By the courtesy of my friend Captain FitzRoy, of Her Majesty's ship "Minotaur," I was favoured, some months ago, with a sight of an admirable scheme of successive evolutionary exercises which he had himself drawn up, and which seemed to me exactly to meet the requirements of a hastily collected fleet, such as even ours must often be. He proposed first to let the ships carry out separately such exercises as may be necessary to give their Officers a correct knowledge of their manœuvring capabilities; next to let the "subdivisions" (I use the word in its present technical sense) manœuvre together; and then to proceed to the general evolutionary exercises. Now, no one, I think, who has observed the difference between the manœuvring of a ship which has just joined one of our ironclad squadrons, and that of the same ship after a few days' practice with her consorts, can have any doubt of the great advantage of some plan of this kind. The different facts obtained in each period of instruction—such as coefficients of speed, requisite amount of helm-angle at different speeds, &c.—should be collected and circulated, as *data* for evolutionary calculations, among the ships of the fleet. This would tend to render homogeneous and compact a fleet, which might otherwise continue only a "fortuitous concourse" of individual vessels. Thus, I also believe, we should succeed in making our FLEET EVOLUTIONS appear to be what they really are, viz., a system of drill and instruction.

I would even give the system the *name* of "drill" or "exercise." Why should not all our evolutionary, and some of our action-signals be codified in a separate *Handbook of Evolutions and Tactics*, which might take its place by the side of the *Manual of Gunnery* and the *Field Exercise Book?* The evolutionary signals have already been separately printed, and a limited number of the books containing them have been issued "confidentially" to the ships; but the work is a mere transcript of a certain number of pages of the Signal Book. Until something of this kind is done, I fear we shall never carry out our annual manœuvres on anything like a definite system, nor is it likely that much instruction will be derived from them.

Supposing our fleet movements to be divided as I propose, practice in the evolutionary, would of course precede that in the tactical portion. The latter should be made to resemble, as closely as our present want of experience would permit, what would take place in actual war. In the first place we should have to consider (and this, as its adoption would inevitably become imperatively necessary whenever

war might be imminent, deserves early and serious thought) the "order of sailing" when likely to meet the enemy. When we reflect how short a time will hereafter elapse between the moment when two fleets sight one another, and that at which it will be possible for them to be effectively engaged, we shall readily understand that this is a question which urgently demands a speedy settlement. The consideration just alluded to—the short interval between sighting the enemy, and action—irresistibly points to the conclusion that our "order of sailing" in time of war must not depart very widely from our formation for battle. As no ship yet devised, can be kept at all times perfectly ready for fighting without some preparation, however minute, we must take steps to gain time. We must have early notice of the enemy's presence, of his whereabouts, of his condition, and of his probable intentions. We must, in fact, patrol—far to the front and flanks—the surrounding sea. We must cover our fleet with a flying squadron of swift ships, the presence of which is not necessary to form the "order of battle." It seems quite unquestionable that we can settle many important points connected with this matter even in the midst of the profoundest peace, provided only that we happen—as we fortunately often do happen—to have a fleet collected together.

How far we are able to construct a system of true tactics for fleets from the experiences of peaceful cruises is, of course, not very definitely certain. From the course of recent history, it follows that we must work at such construction to a great extent in the dark. The rapidity with which science has supplied to us the materials for war, has enormously outstripped the actual warlike demand. The requirements of naval war have been, as it were, forestalled, and we shall have to undertake an almost entirely new work with perfectly new and hitherto untried tools. We are so entirely without experience of actual fighting under the new conditions; we embark on such a vast ocean of doubt whenever we try to forecast the future of naval warfare, that one may be almost forgiven for despairing of ever sighting some friendly light by which to shape one's course. The difficulties in our way should however tempt us to proceed. It is not we naval Officers alone who are checked and discouraged in attempts to pierce the veil which hangs before, and hides from view, that which has yet to be discovered. Our great natural philosopher, Professor Tyndall, speaking of some of the difficulties which beset his experimental investigation of the diathermancy of atmospheric air, says*:—"It is this which daunts the "experimenter; it is this preliminary fight with the entanglements of "a subject, so dark, so doubtful, so uncheering—without any know- "ledge whether the conflict is to lead to anything worth possessing— "which renders discovery difficult and rare." Let his eminent triumphs over such obstacles, encourage us to persevere. Fortunately it happens that in the difficult path of tactical discovery, all have not been disheartened by the apparently insurmountable obstacles that beset it. "It seems at first sight probable," says Captain Colomb,†

* "Heat as a Mode of Motion," third edition, p. 304.

† "The Attack and Defence of Fleets," Part 2, No. LXVI of the Journal of this Institution.

" that no such thing as rule or law can be evolved except from the " facts of experiment in war. It is therefore readily assumed that " naval strategy is not yet in a condition to be made a subject of study." But he goes on to say—" I trust I have shown in former papers " that so far from being the vague conglomerate of conflicting opinion " generally supposed, a very superficial analysis recovers many points " of absolute certainty round which theories may safely revolve, or, at " the very least, gives encouragement to persevere." I cannot refrain from here offering my cordial thanks to the utterer of those cheering sentences.

The preparation of my lecture was almost completed, and it wanted but little to put it definitely into the form in which I am now presenting it to you, when I received the January number of *Naval Science.* The title of an article on " Naval Autumn Manœuvres " naturally—engaged as I had been—attracted my attention, and I lost no time in reading it. My perusal of it filled me both with admiration and despair : admiration for the masterly manner in which the writer had treated his subject, and despair of my ever being able to follow, even remotely, in his footsteps. I felt the wind completely taken out of my sails, and by one too who had evidently a far better right to it than I had. I have no hesitation in qualifying that paper as a " memorable " one ; and I assert with confidence that had it been on a subject connected with our military, as distinguished from our naval, forces, every newspaper in England would have deemed its contents only too well worthy of discussion. I will go farther, and will say that the whole country would have rung with the facts that it disclosed. Who will attempt to deny the truth of this assertion ?—

" It must be first pointed out that while the autumn manœuvres of " the land forces represent the assured results of military science, and " develop in a gigantic game the latest and most approved maxims " of a theory constantly readjusted by appeals to fact, the naval " autumn manœuvres at present represent no more than a vague " groping after something definite at which it is hoped we may arrive " at a future time."—*Naval Science*, No. 4, p. 2.

And this, be it remembered, is said of the fleet of a country of which friends assert and enemies admit that it is the greatest naval Power in the world.

We must, then, make up our minds to evolve from the evolutionary system, which the industry and patient thought of some of our most enlightened Officers have given us, a real system of tactics. We must make more certain and more plain the distinction between true tactics and mere manœuvres, and also the close connection between them, which makes one the basis and foundation of the other. The use of steam has rendered now not only possible but easy, that which some years ago would have been altogether out of reach. " The movements of " steam fleets," says Sir Howard Douglas,* " may, like those of armies, " be conducted on tactical principles best adapted to the *end of all preliminary manœuvres*—the formation for battle in the most simple,

* " Naval Warfare with Steam," p. 87.

"speedy, and precise manner." Our inquiry therefore should be—How far can we make those preliminary movements, which we have already adopted, of service should we ever be called upon to fight an enemy's fleet?

I shall, with your permission, endeavour to foreshadow what, in my opinion, will not improbably be the aspect of a future general action at sea. I shall do so diffidently, and even doubtingly, for—

> " —— modest doubt is called
> The beacon of the wise;"

and it would be dangerous folly to assume that any particularly imagined future is rigidly certain. In the first place, as I have before said, a very short interval will elapse between the moment at which two fleets sight each other and that at which they will begin to fight. At whatever speed they may be proceeding, the fact of the enemy's heaving in sight will be of itself sufficient to cause every ship at once to make ready to increase her's to the utmost when necessary. In whatever formation the hostile squadrons may have been navigating, they will be pretty sure to try and get into one which will enable them to present the bow of every vessel to the enemy. The actual shape of such formation may vary greatly: both fleets may be in "line abreast," or in "line ahead," or in detached groups, or in a close phalanx; or one may be in one formation, and the other in another. Both fleets also may have every component ship in the "line of battle," if I may use that convenient, if not perfectly correct term; or both may have a first line and a reserve; or one may have detached a portion of its whole strength as a reserve, whilst the other may still keep all together. However they may be drawn up, I think that—if both are willing to fight—something like this will take place:—

Both will continue to approach one another at a greater or less speed; that of about 8 knots, I am inclined to believe, will be the most usual. As they approach every gun, which from its position and angle of training can do so with any chance of effect, will most likely be fired at the enemy. As they arrive in closer proximity this bow-fire will become at length ineffectual, and the respective Captains will be disinclined to keep the fore parts of their ships enveloped in clouds of smoke, so it will cease. Now will come the doubly anxious moment of seeking to ram one's antagonist; to avoid being rammed by her; to steer clear of her towed torpedo; and to plant one's own torpedo conveniently under her water-line. About this moment, too, the ships of that fleet which is not in "line abreast" may fire one or both converged broadsides; the fleet that is so formed will be precluded from having recourse to that, probably still advantageous, proceeding. In the early stage of an action, whilst heads are still cool and formations still to a certain extent kept, I venture to think no great damage will be done on either side. I do not mean that no ship will be hit by shot, or even that none will be destroyed by either ram or torpedo. What I do mean is that no fleet, as a whole, will, in my opinion, suffer any serious diminution of its strength at first. The two, I expect, will pass through one another to a great extent intact, till there shall arrive the time which shall be the

crucial test of the value of the evolutionary practice of peaceful times. The two fleets will have to reform and prepare for a second encounter, much resembling that which has just taken place. To paraphrase the remark of a distinguished General,* "Now is the time for the reserve "squadron." Picture to yourselves the effect, moral as well as material, of a well-ordered column of fresh ships bearing down at superior speed upon a group of vessels endeavouring to re-form after passing through an encounter such as I have attempted to describe. Should any vessel have received no other damage than the disabling of her machinery, she will yet be at the mercy of any that, still possessing the power of motion, may be ordered to cannonade or ram her; and, refusing to strike, may, as she lies motionless, be conveniently disposed of by one of Mr. Whitehead's torpedoes, which may be not inaptly termed the successors of the old fire-ships.

Believing, as I think there is fair ground for believing, that something like this will be the course of a general action in future, I may venture to suggest what I deem the best mode of arranging a fleet to engage in it and the proper steps to be taken to carry it to a successful issue. I have no desire to dogmatize; indeed I have not the knowledge sufficient to lay down what may be received as an inflexible law. It is impossible, just at present at least, to bring forward conclusive proof of the superiority of one formation, or of one manœuvre, over any other. The art of tactics is not invariable but ever changing, though always owning allegiance to the eternal laws of strategy. So that, remembering what will very likely be expected from the ships of a fleet in action and the means with which they are supplied for fighting, all that can be usefully done here is to state the advantages and disadvantages of any particular formation or any particular manœuvre. That some one formation is the best for battle—not under all circumstances, but most generally—I do not doubt in the least. My friend, Commander Fisher, in a most interesting little pamphlet, quotes the opinion of a distinguished French Admiral, that "the armour-"plated navy recognizes no fundamental order of battle." Now, no one can have a greater respect than I have for the gallant Navy of France, our worthiest antagonist on the sea; but I cannot avoid the conviction that that sentence does not contain an article of orthodox tactical belief. If by it we are to understand that no undeviating rule for forming a fleet for action should be laid down, then I agree with it; but only then. Depend upon it, Sir Howard Douglas was nearer the truth when he said that the formation for battle in the most "speedy and *precise* manner" was the true end of all preliminary manœuvres.

I hold, then, that we must have some definitely arranged *set of formations* from which to select the one best adapted to the particular circumstances in which our fleet may happen to be placed. One formation appears to me to possess more advantages than all others, that the *peloton*-formation in echelon. The germ of the *peloton* I find is contained in a book of so old a date as the Italian translation of Ramatuelle's "*Tactique Navale*," published at Naples in 1813.

* "Voici le beau moment pour la cavalerie."

Ramatuelle was a Frenchman, and, according to Sir Charles Ekins, was the great authority in tactics in France during the "old war." His countrymen have since elaborated the idea of the *peloton*. His, if I remember right, was composed of four ships. The late Count Bouet-Willaumez proposed a formation with three, and the official *tactique* of the French Navy, if I am rightly informed, contains rules for the formation with both numbers. This attempt to devise a formation for action falls within the true province of the tactician; and it is only after numerous evolutionary experiments, that he can feel any hope of lighting upon that which is best.

All iron-clad ships—to a far greater degree than those of any older type—are constructed so as to be able to deliver a heavy *bow-fire*. Some Officers even think that all broadside-ports should be so constructed as to admit of no fire *abaft* the beam and greatly increased arcs of training *before* the beam. A fleet going into action in "line-ahead" would reduce its bow-fire to that of a single ship, and the number of prows ready for instant attack, to one. Most of our heaviest ships, and those too of other powers, are devised to fire *broadsides*. A fleet in "line abreast" can only fire a broadside from one set of guns in each of two ships on its extreme flanks, and, in fact, only when it is outflanked. A fleet in "bow- or quarter-line" can fire its guns ahead and on the broadside as well, but its rear ships seem to me to lack support. Consequently I think we must adopt an "order of battle" which shall combine as many of the advantages, with as few of the defects, of the formations just enumerated. This appears to me to be found in the echelon of *pelotons*.

I believe I am correct in ascribing the important modification of the original equi-angular *peloton*, known as the "scalene-triangle," to Sir Thomas Symonds and Captain Goodenough. A fleet formed of such *pelotons* in echelon, would at all events have these advantages—no bow gun and no broadside-gun would be masked by a friendly vessel; no consort's hull would intervene between the prow of any ship and the enemy; a slight change, of course, would convert the "order" into "indented line ahead, or abreast;" each leader has a support and a reserve; rallying points are sufficiently numerous for one to be always pretty near after the disorder of a *melée;* and, I think, it enables a fleet to reform in it rapidly. Do not suppose that I am so wedded to this formation for action that I would wish to see its adoption authoritatively imposed upon all Flag Officers in time of war. I assure you I am not. I have no "pet" order-of-battle. I have brought this forward now, chiefly as an illustration of the method by which tactical formations may be evolved from fleet evolutions. On a former occasion and in another place,* I ventured to bring the advantages of this formation to the notice of an assemblage of my brother Officers. My object, then as now, was chiefly to draw attention to the too-neglected subject of NAVAL TACTICS. I was careful then to assert my conviction, "that the actual requirements of battle can never be

* At Plymouth, May 27th, 1872, before the members of the Plymouth United Service Institution.

"provided for in the drill-book or the signal-book." And if I now repeat much of what I then adduced, it is because I still long to obtain more thought and study for this great subject.

My efforts then, such as they were, were kindly seconded by many friends. I soon found myself engaged in a correspondence sufficiently extensive to show that the number of silent students of NAVAL TACTICS, though small, is by no means unimportant. The letter of one of my correspondents contained some remarks so valuable and striking, that I shall make no apology for quoting them:—

"I think that it would be of service if certain *orders* of attack were "invariably accompanied by corresponding *developments* of attack."

Again—

"This strictly tactical movement (that of bringing overwhelming 'force upon some portion of the enemy's fleet) should not be left to "chance or signal, but should be one of the direct logical sequences "of the order of attack adopted; such order of attack being arranged "on sight of the enemy's formation, being governed by it, and calcu- "lated to take the best advantage of it."

These passages occur in a communication which I received from a young Officer, Lieutenant H. Grenfell, whose capacious grasp of the true principles of the ART at so early a period of his service, augurs well for the future tactical efficiency of our Navy, in which, I believe, he will not stand alone.

I shall not occupy your time long in explaining how I believe that FLEET EVOLUTIONS during peace may be turned to account in ascertaining and establishing TACTICAL FORMATIONS and MANŒUVRES for adoption in war. That has been so admirably done in the article in *Naval Science*, to which I have already made allusion, that to those who have read it, I could tell little that they would not have already learned. But one main purpose of this lecture would be unfulfilled if I were not to do so, though briefly, before I finish. One great step towards such a consummation has already been taken. By the practice of the last two or three years, the assemblage annually of two or more squadrons combined under a single chief, has become a recognised naval institution. Up to the present moment we have taken advantage of this collection of the mightiest fleets which the world has ever seen, solely to execute a few drill manœuvres, for no other reason, apparently, than because they are to be found in the signal-book. It is not surprising that even to those who aided in carrying them out, they seemed terribly uninteresting and unmeaning. It would be the same with all drill, if it were to end merely as drill. Turning to the right- or left-about, would be the dreariest occupation ever invented, if it were to lead to nothing but pivotting on the heels. No one would ever take kindly to the motions of spunging and loading, if he did not feel sure that some day he would have to ram home real powder and shot.

I remember when I was one of the gunnery students in the "Excellent"—an *alma mater* for whom I shall always have the greatest veneration and regard—we used to joke each other upon being made to learn in our musketry drill, that "all a soldier's other instruction "in marching and manœuvring can do no more than place him in the

"best possible position for using his weapon with effect." Like many other things which I learnt in the "Excellent," and which in my contemptuous ignorance I then thought useless to a sailor, that short sentence has proved to me a most valuable acquisition. It has at least enabled me to estimate aright the tactical importance of mere evolutionary exercise. From the summer cruises of our "combined fleets" we ought to obtain the knowledge how "to use our weapons (of whatever kind) with effect."

Why should we not take some formation—say, for the sake of argument, that which I have proposed—and forming our fleet in it, advance against a line of targets, previously laid out, supposed to represent an enemy's line? Place the targets in any "order" you please (they might be moored in the mouth of the Channel), we should at least be able to form some estimate of the value of bow-fire when advancing. We might also arrive at some knowledge of the relative handiness of different formations for attack. We might learn, too, how far the smoke from guns or funnels would interfere with the exact maintenance of any given formation. We might also find out which would be the best station for the leaders. I believe we might go further than this, and that we might make one part of the Fleet operate against the other. We might discover how many shots could be fired from a carefully-laid bow-gun when two fleets were rapidly approaching. We might teach ourselves a great deal about the proper rate of speed for action. And we might, I venture to think, gain much practical experience of the offensive and defensive efficiency of the Harvey torpedo in fleet actions; for the ships of each fleet might, in their mock engagement, tow a "dummy" on either side, provided with a few grains of some explosive as a "blowing charge," merely to mark its action. The tactics of the ram, of course, we could not attempt in a fleet, but we might do so with steam-launches, either towing two buoys to represent a ship (as Captain Goodenough has suggested in a letter in my possession), or specially protected against the injuries of collision; or we might, as the Russians have done, try the same thing with small gunboats. Nor is this all that we might do with our Fleet in peace to prepare us for the very object of our existence as naval Officers, viz., the perfecting of our efficiency in war. We might, as has been suggested to me by Captain Wilson of Her Majesty's ship "Impregnable," pit one division of our Fleet against another as blockaders and blockaded, and thus illustrate what the history of the Crimean and Franco-German contests shows would be no unusual occupation of ships in war.

I believe I can easily prove that there is nothing new, nothing that will cause great expense, and nothing dangerous to the ships in the proposals I have brought forward. Unfortunately, it is not only such objections as those that have to be met by anyone who desires to advance the tactical efficiency of the Service. Some amongst us there are, who deem all evolutionary practice useless; who, relying upon their own undoubted skill and heaven-sent gift (for such it is) of deftly handling ships and squadrons, decry the instruction of others less gifted than themselves; who, because the extraordinary and original genius of a great naval architect has given us ships which are the admiration and

the models of the navies of the world, think that with their guns and *rams* we must, in the old headlong, inconsiderate way, bear down all that dare to stand against us. I wish that those who think thus, would study the tactical history of the Navy a little. In it they would find, how in our "dark age" of NAVAL TACTICS, the British Fleet won few victories, and no very glorious ones; and how, till the era of true tactical knowledge dawned, the actions in which it was engaged were, as a rule, indecisive or partial. They would find how patient a student of tactics was even our great Nelson, who spent many an hour in pondering over all the possible circumstances of battle, and whose favourite occupation it was to listen while the chaplain read to him from Clerk of Eldin's *Essay*. They should remember Captain Colomb's apophthegm, that "the brave man had better be intelligently brave while he is about it." Surely to them we may apply the words which Shakespeare puts into the mouth of Ulysses; for they indeed it is, who—

> "Count wisdom as no member of the war;
> Fore-stall pre-scíence, and esteem no act
> But that of hand: the still and mental parts—
> That do contrive how many hands shall strike
> When fitness calls them on; and know, by measure
> Of their observant toil, the enemies' weight,—
> Why, this hath not a finger's dignity:
> They call this—bed-work, mappery, closet-war;
> So that the ram that batters down the wall,
> For the great swing and rudeness of his poize,
> They place before his hand that made the engine,
> Or those, that with the fine-ness of their souls,
> By reason guide his execution."—
>
> *Troilus and Cress.*, act i, sc. 3.

Yet it was by the aid of such "closet-war" that Rodney restored the prestige of the British Navy; and in our day we have seen how the "observant toil" of Von Moltke and his assistants has ended in shaping the destinies of Europe for many years to come.

It will be easy to estimate roughly the expense of such exercises as those I suggest. Put the number of ships in the Fleet at twelve. Let them—devoting Saturday and Sunday to the two neighbour virtues of cleanliness and godliness—manœuvre for five days in each of two consecutive weeks, and for four hours a-day. That would give a total of forty hours' exercise. Two tons' extra expenditure of coal per hour for each of the twelve ships would amount to nine hundred and sixty tons, which, at thirty shillings* per ton, would cost less than fifteen hundred pounds. At this rate I fancy the sea-fights at Admiralty Patch or Middle Deep would necessitate but a small fraction of the expenditure caused by the battles of Codford Bridge or the Hog's Back.

All naval history proves the wisdom of some such exercise. There is nothing new in it. In one of the oldest-recorded sea-fights, that at Ladé, the defeat of the Ionians by the Persians was mainly caused by the Samians' undisciplined impatience of the tactical instruction of

* Since this was written the price of coals has enormously increased; still it may be hoped that it will have fallen about the months of July or August.

the Phocæan admiral, Dionysius. Any one who cares to follow up the subject, will find in that admirable newspaper, the *New York Army and Navy Journal*, a series of essays—now in course of publication—on ancient and mediæval sea-fights by a distinguished and accomplished Officer of the American Navy, Captain Foxhall Parker. They will be found to be not only papers of considerable literary merit, but also highly interesting as showing the unbroken continuity of tactical knowledge and practice in former days. In the least scientific age of our own naval power, the proceedings of our Fleets, such as they were, indicated the same careful preparation. "It is difficult, almost im-"possible," says Mr. Laughton, in a remarkable essay on *The Sovereignty of the Sea*,* which every naval Officer should read, "to under-"stand how ships of the clumsy form and rig, which was the neces-"sity of the age, could manœuvre at all * * * but, if there be "any truth in history, the English ships did manœuvre, and that, too, "in some species of formation." In the *Calendar of State Papers*, I find an abstract of a letter from Sir William Clerke to Secretary Williamson, dated "Royal Charles," The Downs, May 30th, 1666, in which the writer says, "They have been *modelling* the Fleet." We who have so often seen hoisted the signal to "Take down in writing the *organisa-"tion* of the Fleet," will readily understand what that means.

The proposal, therefore, to improve our tactical knowledge is one sanctioned by appeals to experience, is not rendered impossible by great additional expense, and is recommended by every principle of policy to our adoption. At the present moment, NAVAL TACTICS can be scarcely said to exist. What have we done to advance the art since the introduction of steam? Take the few lines of tactical suggestions prefixed to the action-signals of our present signal-book. Is there—with the single exception of the one which does acknowledge the existence of steam-power—any which would not have been as suitable to the days of the Armada as to our own? One indeed does breathe something like a faint inspiration of obsolete tactical principles. I cannot, of course, quote the words of the signal-book here; but I may say that in the volume (clxiv) of the *Calendar of State Papers* already mentioned, will be found notice of a letter from Prince Rupert to the King, in which, after asserting his "zeal for the Service" (for the art of blowing one's own trumpet was as well understood in the Prince's day as in our own), he says, "The *additional orders* show his anxiety "to follow instructions." He encloses a copy of these *orders* from which I make the following extract:—

> "Additional fighting instructions; being orders for forming the line of battle in "case of attack or defence, and in different conditions of the wind. The Com-"manders are forbidden, on pain of death, *to fire over any of their own ships*."

The milder manners of our own age have softened the penalty; we have hardly improved upon the instructions. What we require is a set of tactical maxims or rules, drawn up in accordance with the requirements of modern sea-warfare: not necessarily containing absolutely

* "Fortnightly Review," August 1st, 1866, p. 724.

imperative injunctions, but laying down in clear, unmistakable terms, the broad principles of NAVAL TACTICS.

Gentlemen, I have already taken up too much of your time in what, I fear, has been but a dreary explanation of a dreary, although an important, subject. If I have been tedious, it was because I wished to persist in trying to arouse the feeling that the British Navy is bound to show the way in this, as in other paths, to the navies of the world.* Standing here beneath the very roof that covers so many relics of our heroic past, I cannot but remember that we are the holders of a glorious heritage; we are the representatives and professional descendants of the gallant spirits who won for our country the sovereignty of the seas. True, in the zenith of her power she voluntarily abandoned the right to it; and "it is now," to use the words of one† who, in the study of naval history, has been my master and guide, "only a "memory of those past times, when an unrestrained barter of cotton "and sour wine was not supposed to be all that was necessary for the "advantage of a nation."‡ The titular sovereignty having been thus freely laid aside, it is more than ever incumbent on us to fortify and secure the real and virtual power. Those of us who attempt to do so, will find that there are many difficulties to oppose, many obstacles to overcome. The record of past achievements should cheer us on, for it is truly "a stirring sound." We do not indeed, in our attempts to improve the tactical efficiency of the Navy (to borrow another phrase from the great historian,§ whose words I have just quoted), "fight beneath the cold shade of those above us!" Our contest is waged beneath a chiller shadow; that of popular indifference and of too-frequent professional apathy and neglect.

Captain GOODENOUGH, R.N.: I rise, merely to ask Captain Bridge to correct a small point in his exceedingly interesting and very suggestive paper. I would ask him to correct what he states with reference to the formation of ships in *pelotons* of scalene-triangles, which he said was due to Sir Thomas Symonds and myself. It was due to Sir Thomas Symonds alone, who thought of it, and worked it out. I can only say I think in certain cases it might be made great use of, because while you have two ships in the position of your attack and of your support, you have the third at a free distance as your reserve ship.

On the general subject of "Naval Tactics," I think we cannot do better in a time of great uncertainty, than to heap up as many propositions and as many ideas of tactics as possible, and then proceed by trials in our squadrons at sea, to demolish those which are shown to be utterly useless.

There is one thing which I think both the Lecturer and Captain Colomb—who are more than students of the art of naval tactics,—might do for us, and that is to define a few of the terms which are used in maritime warfare; for instance, such terms as "evolution," "tactics," "manœuvres," "strategy." Before we can set out on an examination of "naval tactics;" before a useful paper can be written such as it is pro-

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* "—— and if now and then I shall seem to warm into a style somewhat too stilted and pompous, let me be excused for my subject's sake."—*C. Kingsley.*

† Mr. J. K. Laughton, R.N., in "Fortnightly Review," *loc. cit.*

‡ A naval Officer's opinion upon freedom of trade, or any other politico-economical question, is not likely to be thought of much weight; but I may say that, though no one probably goes farther than myself in advocacy of the most unfettered liberty of commerce, I yet agree with our ancestors that it is "*not all that is necessary*" to a nation.—C. A. G. B.

§ Sir William Napier.

posed shall be written by persons who are asked to compete for the prize offered by the Junior Naval Professional Association, we should have these four terms properly defined.

Captain COLOMB, R.N.: I have some difficulty in addressing the meeting, because I am not accustomed to receive what I must call the undeserved praise that has been given to my little endeavours to put this question on a right footing. Possibly there may have been some policy on the part of the Lecturer in beginning with a tribute to my small labours, because when a man is so flattered at the beginning, he is not very ready to offer hostile criticism farther on. But I think, whatever might have been said, my feeling on following the paper, as I have done, word by word, would have been the same, namely, that we have had a remarkably clear, concise, and able exposition of the state of "naval tactics" at the present moment. I am not aware that I have ever read, certainly I have never listened to, so complete a description in a short space, of the points that must be attended to in dealing with this question of "naval-tactics."

I take first the question of exercise. The Lecturer draws from the Italian translation of the French work which he has quoted, these words:—"The art of naval tactics requires continual evolutionary exercise; for merely knowing its rules will not suffice in order to practise it correctly." I am sure there never were truer words said as to the practice of naval tactics. I have had in my time to take boats out for drill; I have drilled models on the table, and I suppose I may be allowed to know a little of the present system of tactics in the Navy; but when I see what I have learned from books, or from the manœuvring of boats, put into practice in a fleet, I feel I am dealing with something totally different. The distances you have to deal with are so great, the question of smoke, the difficulty of making out signals, the difficulty of conveying the Admiral's wishes along the line from ship to are so unexpected, that you feel at once the truth of that saying.

The Lecturer next passed to the question of classifying "naval evolutions," and I almost entirely agree with the classification that he has put forward, viz., first, to take the single ship as to what she can do; then to come to manœuvring collectively in small aggregations, as I suppose he put it; and next, after you have arrived at some satisfactory platform on that point, to pass to more complicated manœuvres.

Captain Goodenough has spoken on a point very nearly analogous to that, on the question of the definition of terms; and that is a most important one. We have been obliged to construct for the Navy as we stand at present, a terminology which has gone a certain way, but is still very defective. We want a much closer definition of the terms we use. Captain Goodenough mentioned some, but there are many others. For instance, you want a term to refer the mind at once to the relative position of ships in their columns, and you want a second term to refer the mind at once to the relative position of the columns in a fleet. You may have ships in quarter-line, and you may also have the columns in quarter-line. The ships in each column may be in line-abreast, in line-ahead, or in quarter-line. The columns in the Fleet may also be in line-ahead, line-abreast, or quarter-line. (Captain BRIDGES: In echelon.) Echelon, as you call it; I call it quarter-line, because it is the recognised term. You have at present no term to express these two things; you mix them together. You say the Fleet is in a certain "formation," when you do not convey by that term the fact that the ships in their columns are disposed in one particular way, and that the columns in the Fleet are disposed, perhaps, in another particular way. Terms are wanted readily to express these conditions.

The Lecturer next comes to the question of exercise, and he says: "Not only do I think that repeated exercise in all such evolutions is necessary to give us the power of imparting strength and flexibility to our fleet-formations; but I also feel convinced that it is by such exercise alone that we can ever hope to discover what manœuvres will be of most advantage to us if we are ever to fight another general action at sea." There again is a distinct and clear point. It is only by constant experiment, and, as Captain Goodenough has stated the excision of those movements and formations, which are found to be useless, that you can ever make any progress.

The Lecturer speaks strongly about the separation of drill from tactics, and that is a point on which I also am very strong. Your drill is quite a different thing from your tactics; it is a matter of exercising the nerve and brain, and teaching Officers

by more complicated manœuvres to be confident, when the simple manœuvre comes which is to take them into battle. He next says the way to separate drill from tactics is to have a drill book for our Fleets. It is not more than a few days since that I wrote pointing out, that that was the only solution of the question at the present time. You cannot be perpetually altering the official book, which you might have to depend upon at any moment in war. But if you have a separate drill-book, which is to be used for drill and for experiment only, you may make it as large as you like. You may introduce any sort of manœuvre that anybody proposes, and you may give the Fleet the power of working with this drill-book, for experiment and drill, and you may make it a feeder to the recognised official tactics of the Navy. That is to say, by having a drill-book, so to speak, not official, you may, as your knowledge increases, and your experience enables you to detect what is right and what is wrong, recognise with certainty in your official "signal-book," those movements which you desire to retain, and you may put out of sight those which you do not desire to retain.

The next point that I wish to draw attention to, is analogous: "We must, "then, make up our minds to evolve from the evolutionary system, which the industry "and patient thought of some of our most enlightened Officers have given us, a real "system of tactics. We must make more certain and more plain, the distinction "between true tactics and mere manœuvres, and also the close connection between "them, which makes one the basis and foundation of the other." I have nothing to add to these words, and have only to express my agreement with them.

The Lecturer draws attention to the very short interval of time that would "elapse between the moment at which two fleets sight each other, and that at which "they will begin to fight." A brother Officer of mine meeting me the other day, said, "I do not agree with you in your views of tactics. You like a great deal of manœuvring." I said, "I am very sorry for that. I am afraid you have not quite gathered what I have endeavoured to convey," because I am satisfied with the Lecturer, that unless your mind is made up beforehand, unless your "sailing formation," as he puts it, is very closely analogous to your fighting formation, you will find yourself in a difficulty. There will be no time to make dispositions in the event of meeting a fleet; your dispositions must be made before hand, your sailing formation must be such as will at least enable you to pass to your fighting formation, in the shortest possible time. Signals and manœuvres are, I take it, quite out of the question.

Then the lecturer proceeds to describe what he supposes will be the course of a naval action. He puts the speed at about eight knots. I have always put it at ten knots myself, because that has seemed to me the general idea of the Navy; but if I were to express my private opinion, I should say it would more likely be eight knots than ten knots. Then the lecturer goes on to point out that he believes the "fleets will in the first instance pass through one another intact." Now they say naval Officers never agree, but I must say I do agree with him on that point. I believe the fleets would pass virtually intact, that there would be, as he describes it, a re-formation, and that that fleet which re-forms quickest and is most ready to begin again, stands a very good chance of winning the day.

Now we come to the "peloton," which is a very disputed point. The peloton, I believe, was omitted from the original edition of the signal book, because it was said—and I agreed, I think, that we knew nothing about it—we did not know what its real value was. It afterwards crept into the signal book, because it was said to possess a certain value. But the system of manœuvring by pelotons is quite a distinct method of manœuvring a fleet. In the case of a peloton, you take your three ships or your four ships in a group, and you consider and treat that group as a single ship. Theoretically, the ships in a group do not alter their formation. In the group of three for instance, you give the leader the charge of that group; you give the starboard ship we will say a position close by on the starboard quarter; you give the port ship a position distant on the port quarter. The orders those ships have, are in all cases to maintain those positions, roughly of course, but still their rallying points are those. Well now, a fleet arranged in groups or pelotons in this way, becomes very mobile, inasmuch as you manœuvre the group as though it were a single ship. If you have a fleet of twelve ships, your signals would be the same as if you had only

a column of four ships, you do not trouble anybody, but the leaders of the groups, and it is supposed that the men who are leading each group are picked men, capable men, who exercise their command over the small group. The theoretical effect is that when the group of three is used, you reduce the chances of error by two-thirds; that is to say, if you make your signal, whatever it may be, to nine individual ships, some of those individual ships may go wrong, the signal may be mistaken; but if you address your signal to three of those ships—the other ships having merely particular stations to keep—you run much less chance of confusion and error. I am not prepared to say that that is the system of tactics of the future, but I am prepared to say that it is a matter that should be, like every other question of naval tactics, thoroughly worked out, because as the lecturer said, and I quite agree with him, we are not on at all sure ground, we want experiment to guide us. I think these are all the points that I need advert to. I must congratulate Captain Bridge on the very excellent lecture he has given us.

Commander W. Dawson, R.N.: The naval Service must be congratulated that an Officer should be still left on the active-list capable of producing such an able and eloquent paper as that we have heard to-night; and who has also the moral courage to study and to form opinions upon a professional subject, and to express those opinions publicly. Moral courage on professional subjects is not so very plentiful in the Navy but that we must observe with gratification that, notwithstanding recent legislation, an Officer is found with anything to lose, who is possessed of that risky qualification. I gather from the paper that the Navy still holds to the idea that there is "a royal road to learning," some instinctive way by which Officers can acquire knowledge and skill in the profession without practising it. When landsmen are particularly ignorant on any subject, they say they are "at sea" on that subject, and I presume that as to tactical exercises, it is in that sense that the Navy is "at sea." Perhaps the fleet is only in that sense "at sea," that is to say, "not at home" in tactical manœuvres, that there has been a want of intelligent direction at head-quarters on this subject. One of the first things required in order that tactical manœuvres may be fairly tested is, the appointment of a standing "tactical committee" to meet in London, say for the three winter months in every year, for the purpose of collecting and collating what has been done by the squadrons on each of the nine foreign stations in the course of the previous twelve months, to elucidate tactics at sea; and of suggesting what ought to be done by each of the nine squadrons in the succeeding twelve months: an Experimental or Training Committee if you choose to call it so, on naval tactics, consisting of thoughtful Officers, capable of learning themselves and of forming intelligent opinions upon difficult and novel matters. If this was a military question, instead of a naval one, we should have half a dozen committees sitting every year, each charged with the examination of a separate subdivision of the subject, and the matter would be exhausted by crucial experiments carried out in all sorts of ways under all possible conditions; but being a naval subject, it is otherwise.

It is deplorable that notwithstanding the annual expenditure of so many millions sterling upon the Navy, and the crying necessity for careful investigation arising out of the recent introduction of so many novelties in ships, propulsion, turning-apparatus, guns, armour, rams and torpedoes, we should still have in a discussion on tactics to deal solely with opinions, and that we should have no facts; for not a single fact has been brought before us to night. A few facts have, it is true, been brought from Russia and France, and other foreign navies, but none from the British Navy. Why is this? Why, without burning a single extra ton of coals, it would be possible to chronicle the movements which are being performed at this very moment. Every week there are ships going out of Portsmouth, Plymouth, and Sheerness, for the purpose of trying their turning powers and speed at the measured mile. Why cannot the Steam Reserve Officers be directed to chronicle the angles of helm required to turn each of those ships, in one common tactical half-circle, at one uniform rate of speed, say eight knots, as well as the minimum half-circle at highest speed? Why cannot some persons of intelligence be employed to put the results together and tabulate them so that when ships meet together, the Admiral of the Fleet may be able to turn to that table, and say, "That ship is so long, she cannot re-"verse her course without describing such and such a half-circle; the whole

"fleet must be guided by that ship's turning power," and the Captain of every other ship present should know what is the helm-angle which will cause his vessel to describe a similar half-circle similar in point of speed—we want the information which already exists, tabulated and circulated—but which it is nobody's business to tabulate and circulate—for the guidance not only of tacticians, but of fleets. I am one of those who go in very strongly for extreme simplicity in all essential tactical manœuvres. By that I am to be understood as drawing a wide distinction between those manœuvres which are simply requisite, in order to exercise the nerve and judgment of individuals, and to enable them to gain experience and confidence not only in their own powers, but in the capabilities of their respective vessels, and those other manœuvres which are to be practised in the presence of the enemy. Speaking of the latter part of our duty, I think the tactics for future naval battles cannot be too simple. We must look forward to future war-fleets being at the outset of a great maritime struggle, composed very much as old war fleets were, viz., with Officers placed suddenly in command who have not heretofore had the opportunity of serving in evolutionary fleets. These Captains will have under them junior Officers who have also had no experience of the kind; and they will have half-disciplined and partially trained crews, who will occupy a great deal of the personal attention of the Commanding Officers, diverting their minds from the novel study of fleet-tactics. For these reasons, manœuvres that are absolutely essential for handling a fleet in the presence of an enemy, should be made as simple and as few as it is possible to devise. There appear to me to be two modes of approaching an enemy: first with double columns, in line ahead; and secondly, with a more or less extended front, presenting indented lines of one form or another, varying in character with every change of course. But which of these should be selected for the approach, will depend very much upon the formation of the enemy. If the enemy were coming up in two columns in line ahead, it would be a waste of power to mask your own batteries by attacking that enemy in a very extended line. The enemy would in fact concentrate his whole force upon two ships in width of your extended line, so that, in that case, the enemy's formation would compel the adoption on your part of a small front and great depth, such as would be obtained by some formation like that of "double-columns in line ahead." The question is, whether even if the enemy be formed in an extended line, you would not do better by concentrating the whole of your force upon the smallest portion of his line, and this would be effected by attacking him in "double columns in line ahead." An extended formation, whether in echellon or otherwise, would be chiefly useful against a retiring or pursuing foe. If the attack upon a willing enemy be made in extended line, that formation should be adopted which will admit of the maximum of flexibility, with the least confusion in frequent and rapid changes of course, and that can be most readily reversed after each charge. This, and not the best theoretical formation for the delivery of artillery fire, seems the governing condition. This if arranged so as not to mask each other's fire on one course, will do so on any considerable alteration of course. Artillery fire will not be very effective in the rapid movements which will take place when one fleet charges another. I have no particularly great faith in our gunnery practice at present. It is capable of much improvement; but even when it is so improved, you cannot expect many useful hits to proceed from bow fire, supposing both fleets to be approaching each other at great speed. Of course, in case of a retiring enemy, bow fire would become a very important element, and the more indented and extended your line, the better. I am not one of those who think it may not sometimes be necessary for tactical purposes to show your stern to the enemy. It may be necessary when you pass through the line to be able to fire abaft the beam and astern as well as a-head. Nor can we always expect to be strong enough to be the attacking fleet; and stern fire is essential in a running fight. In dealing with tactical manœuvres in the presence of an enemy, we must not forget that a number of unarmoured ships will be in company. If the enemy be allowed to cut off the ironclads from all the unarmoured vessels, it would not be his policy to leave those small ships unmolested. And when the ironclads have passed through the enemy's line, he will be in the middle of the fleet, and have the choice of attacking the unarmoured division without turning round or of turning to resume the charge. But he would hardly risk turning his

fleet round if a wooden squadron were ready to avail themselves of the necessary confusion; and he might prefer to continue his course and attempt the destruction of the unarmoured and reserve divisions. We have not heard to-night very much on the subject of rams. I am glad to see that Captain Bridge accepts the idea that each ship, armoured or unarmoured, would materially protect herself against rams by the employment of the towed torpedo as a defensive weapon. There is a vast difference between the employment of that weapon defensively and offensively. Offensively, no doubt a great deal of skill and manœuvring with special vessels of high speed and quick turning power is necessary; but defensively, when towing it merely from the fore part of the ship for the purpose of keeping off rams, no such exceptional skill is needful, and I believe that that will turn out to be the most important use of that weapon in fleet actions. Whenever divergent torpedoes, diverging 80 to 100 yards on each beam, are towed from the bows of armed ships, other vessels will hesitate to ram, and ramming will be reduced to a minimum. Of course ramming would not be altogether abandoned for this cause, as the divergent torpedo requires high speed, and any derangement to the ship's machinery would deprive her of this protection. Even then, however, outrigger torpedoes might be rigged out if a ram approached. Still a daring Officer would not throw away a good opportunity of ramming a moving ship on the bow: but when it came to ramming a hostile ship abaft the beam, the presence of a divergent torpedo would make it a rather dangerous proceeding.

The whole subject of naval tactics is, at present, one of opinion, without any basis of experimental data; but there is one point to which I should like to draw attention, namely, the absurdly "confidential" character of the tactical drill-book. A reason not yet touched upon, why the drill-book should be circulated independently of the "general signal-book," is that the majority of the Officers afloat have never had the opportunity of serving in squadrons. Not only have they thus no practical acquaintance with fleet work, but they labour so hard when on full pay, that they have neither strength nor time for professional duties. When they come on shore on promotion for a temporary period of half-pay, they have probably more leisure than they ever had in their lives. I met a young Captain in the country the other day studying mangold wurtzels and turnips. On asking him why he had given up the profession, he indignantly replied that he had not done so, but that his present occupations were dictated by his extreme anxiety to obtain a command and to advance in his profession. He was afraid if he lived anywhere in the sight of naval subjects, he might be induced to study the different changes that take place in the present day, and thus to form opinions on professional subjects; the expression of which might militate against his obtaining a command when his turn came, and that thus professional ruin might, under recent legislation, attend his professional studies. He had therefore retired to the country, so that being supposed to have no professional opinions he might when his turn came, not be passed over and ostracised from the profession he dearly loved, but have a chance of serving again. Now I say that Officers temporarily on half-pay might profit very much and the public service profit also by their enhanced knowledge, if they had the opportunity of studying the tactical drill-book during their enforced leisure on shore. The Junior Naval Professional Association has come forward most patriotically with an offer of fifty guineas for an Essay on the Tactics of Future Naval Battles. But every Officer is precluded from competing for that Prize Essay unless he happens to be on full pay, for the pressing reason that the existing tactical drill-book, which is an essential element of study for such a competition, is withheld from him, though it is doubtless furnished to every foreign embassy in London. The book is not to be found in the library of this Institution, because it is included in a "confidential" volume called the "General Signal Book." But if the drill-book or Manual of Tactical Science recognised by the Admiralty, was not sealed up from British Naval Officers as a "confidential" publication, then Officers temporarily on half-pay would be at liberty to employ their leisure time in preparing themselves for future commands by close and careful study of tactical questions; and even old discarded Officers like myself might be allowed the satisfaction of earning our retired pittance by employing our brains to the good of our country, and the opportunity of showing that even though we are prematurely discarded, we have still

some brains left, and some intelligent love for that noble profession which, under whatever adverse conditions, we cannot but desire to see honoring the proud heritage handed down to it, by maintaining its high position as the chief defence to our island dominion.

Captain Wheatley, R.N. :—In the few remarks I purpose making, I shall confine myself entirely to tactics. In the first place, before we can do anything with tactics we must have ships that can manœuvre alike. I have mentioned before in this Institution that I am for bow-fire. I also consider that with line-abreast you get a greater power of formation, whatever the formation of the enemy may be. One thing has not been mentioned, and that is the power we have in steamers which makes them even superior to a body of men on shore—I mean the power of stern-movement. Suppose, instead of advancing at ten knots an hour, you back astern. You will then have more time to see what your guns will do. You will not go ten knots, of course, but you will be better able to see what your guns will do. The enemy coming on at ten knots, will get into greater disorder than you will. If he comes on in scalene formation, your outer ships bring their guns to bear upon his bow and upon only two or three ships. Actions at sea have always been gained by leaving some few of the enemy's ships completely free. In the first instance you can bring a greater power to bear on the leading ships by backing astern. Supposing he comes on in line-abreast, you may very easily withdraw one wing and bring your line at right angles to your first formation, forming on the weather flank ship. The enemy will pass in front of you ; he will be covered by the smoke, and you bring the strongest part and the greater number of your guns against his weakest side. And if he comes on in two divisions or two lines ahead, you have only to part in the middle and bring the same formation to bear on his line as he passes—you bring your bow guns to bear on his broadside.

The Chairman : Before I give your thanks to Captain Bridge, which I am sure you will allow me to do, I should like to make a few remarks. Captain Wheatley has recommended to your notice a novel method of attacking the enemy, and that is by going *astern.* But it must be remembered that screw ships going astern must inevitably go in one direction, viz., stem to the wind—that is the only way in which we can induce screw steamers to move—and therefore that species of manœuvring will not do for the purpose of receiving the attack of an enemy.

Captain Bridge has alluded to a pleasant cruise we had together some few years ago in the Channel Fleet, when he was my Flag Lieutenant, a service relationship to which I always look back with great satisfaction. He spoke of the method of teaching tactics and practising them in gunboats and steam launches. Undoubtedly, as Captain Colomb says, there is a wide distinction between such practice and real practice with full sized vessels. Unfortunately we have very little of either. I do not think we have ever had any real practice with gunboats, though certainly that would be better than nothing, when we remember how few Officers serve for a short time, if at all, in a fleet. I believe the Russians carry out gunboat exercise of fleet evolutions perseveringly. I am not quite sure whether the French do so, but the Russians certainly do. They protect the bow of the gunboat with some sort of buffer, and then the cleverness of the young Lieutenants is tested by their attempting to ram one another, and I am told, although it is hardly probable, that there is one Russian Lieutenant who proved so expert that he has never yet been rammed.

There is one subject upon which Captain Bridge has not touched, and I dare say he avoided doing so because we shall have a paper on this subject before the Session breaks up, viz., on the "Naval War Game." It occurred to me some time ago that while the Army are enjoying their tournaments over the military "war game," nobody has yet brought before the world any attempt to have a naval "war game." There is a gentleman in the Fleet, I may mention his name, Lieutenant Castle, of the "Hercules," who is endeavouring to prepare a paper for us on that subject, and probably we may have a naval war game and naval tournaments in this theatre this year as there are military tournaments now at Woolwich.

We have heard remarks from several persons about the "confidential" drill book. I have long held the opinion that confidential reports, whether reports of Officers' characters, or drill books, or whatever they may be, are a myth. I do not believe in

confidential reports ; they generally leak out. If you attempt to maintain a secret in a professional matter, you first of all suggest to persons interested that it is very important, and then they consider it their bounden duty to attempt to obtain possession of it, and thus you tempt them to pursue uuworthy means of getting information; you tempt foreigners to get the information from persons in subordinate positions who may be able to give them the information. I do not say that they always succeed, but the temptation is most mischievous. The whole thing, I believe, is a great mistake from beginning to end. I shall be very glad to see, as far as possible, all confidential work of this kind done away with; it is, as a general rule, perfectly inoperative, and the sooner it is given up, the better. Besides which, the confidential book, whether a "torpedo" book or a drill book, or whatever it may be, who is it that never sees that book, and who is it that always has a copy in his possession? The persons who never see it are the persons who ought to see it and study it, viz., the Officers on ships or on shore, who in the latter case can well spend their spare time in studying it. And who are the persons sure to have a copy of it? Why they are the Officers of other nations who take an interest in the question, and I am bound to say have a copy of these books in their possession now, at the present moment, supplied by their Governments, and study them as often as they wish. Therefore I contend the whole question of "confidential" books should be reconsidered. I know as a matter of fact that the Russian Admiral had a copy of the naval signals of every nation, the English book in manuscript. Mention was made of the shortness of time that would elapse after ships came in sight of one another before they were at close quarters. It is well that we should remember what that shortness of time is. Eight miles an hour is the speed which Captain Bridge has given, and which Captain Colomb endorsed. Anybody can understand that if the fleets are four miles apart and steaming towards one another at that speed, in fifteen minutes they will be alongside of one another. Now fifteen minutes is a very short time to change a position, and therefore it is now more than ever incumbent on those who command fleets, to keep their ships in a good position for entering into action, and also for all Officers to be especially wide awake. I trust that we have a signal now, as the French have, which would enable ships that are in some other formation to change it by passing rapidly, without going through any tortuous manœuvre, into the position in which it may be necessary to place them for action, the only rule being that when one ship has to pass near another, the junior Captain passes under the stern of a Captain senior to himself. No other direction is given but that, and they are allowed to get into their places as soon as they can. I do not say that is a manœuvre that ought to be practised ordinarily, but there are occasions when such a manœuvre would be of importance. I see Captain Colomb shakes his head. (Captain Colomb: I do not shake my head with reference to the usefulness of the manœuvre, but only because of the fact that we have no such signal). With regard to the peloton. Captain Bridge was pleased to say I introduced it into the Fleet. Really Captain Colomb introduced it, because Captain Colomb in his first lecture on Naval Tactics first drew our attention to the peloton, and spoke of it as a formation adopted by the French Navy. When I was in the Channel Fleet the other day, I brought it under the attention of Sir Thomas Symonds, and it has been considered and introduced into our tactical formation. But Captain Colomb is the real introducer of it, after the French, of course, to whom we owe it. One advantage of the peloton is this, and one which no doubt was included in Captain Colomb's view, and that is, that in the smoke of battle we shall not see our Admiral's signals; they will be utterly lost sight of. You will see the ship next you, and you may see the next but one, but as for the Admiral, four or five or more spaces off, you may know nothing about him except that you may hear his guns occasionally. There is therefore that advantage in the peloton, that the two ships attached to the leading ship have some chance of following somebody's motions, and of sticking to and aiding some ship, whereas if the peloton or some similar formation is not adopted, they will all be looking for the Admiral's signals. The peloton, therefore, is one of the best formations we can have. I do not know whether it has been adopted in our Army. It has been adopted a long time ago in the French Army, and I believe great importance is attached to it. Three men hang together and support one another in action.

I do not think too much can be said about the importance of bow fire in our ships. In the later designs of ships we are paying more and more attention to it. There is enormous importance to be attached to it. The stern fire is, of course, almost as important as the bow fire, and is also being paid more attention to.

With regard to the summer cruises, I concur with what has been said, that we do not get enough out of our summer cruises. I suppose there is some practical difficulty in the way, otherwise we should; but certainly the suggestions made in the paper in "Naval Science," now endorsed by Captain Bridge, are exceedingly valuable; and we may trust and hope that in our next squadron-manœuvres the very valuable suggestions may be carried out.

I am sure you will allow me to return your thanks to Captain Bridge for his interesting and instructive lecture.

Captain Bridge: Captain Goodenough was kind enough to correct me in attributing to him, in conjunction with Sir Thomas Symonds, the merit of having introduced that very important modification of the peloton-formation into the service. I have always understood that in the service it has been attributed, if not entirely, at all events in great measure to him, and I had the less hesitation in inserting in my paper what I read to you. But of all the remarks that have been made to-night, nothing seems to me to have been so important as that made by Captain Goodenough, in which he insisted upon the necessity for a definition of such words as "tactics," "evolutions," "manœuvres," and "strategy." That is where, in my study of the subject, I have found that we are so hopelessly and altogether adrift, and until that is done—and it must be done either by authority or under the shelter of authority—we may almost as well leave the study of tactics altogether on one side.

Nothing, I am sure, can give me greater pleasure than to find that Captain Colomb and myself agree with regard to the speed at which fleets are likely to engage. That is immensely important, and we cannot think too often of it, for if we arrive at some satisfactory conclusion about it, we have not fought half the battle, but nine-tenths of the battle.

Captain Dawson has made this evening—as I find from the Journals of this Institution he has been in the habit of making—very many valuable remarks upon the paper. He speaks in the first place of the want of moral courage of naval Officers. I do not think that that is exactly a fair charge to bring against Officers who are now serving, and I think it is—not that Captain Dawson has unfairly charged us with anything—but he has rather mistaken what is the real state of affairs. We were talking of definitions just now, and I think he has defined the thing inaccurately; he has applied the term "want of moral courage" to that which is not want of moral courage, but that which is modesty; and I can claim no credit on this score of modesty. There are many Officers, certainly several of my own acquaintance, who are not only as able, but very much better able than I am, to come and address such a meeting as this, but their modesty has restrained them. It is no want of moral courage, but they feel that young Officers ought not to put themselves into such a position as that which I, from, perhaps, not moral courage, but forwardness, have done.

To go on to another thing, which is, perhaps, less abstract and more concrete than what I have just said. Commander Dawson suggests that committees should sit to inquire into questions of this sort. I quite agree with him. I think it is a great misfortune that we have nothing of this sort. We have, as he says, few facts, but many opinions, and we can only get facts—(it seems to me to be a defect in the English mind)—we can only get facts by cross-examination. We must have a sort of Tichborne trial before we can get at anything like the truth. He also made a remark about ships going out of harbour, and the great advantage that might accrue to the service from the record of the angles of helm necessary for turning a certain number of points. Now that I inserted in the body of my lecture, and I ought to have said, and if it ever appears in the Journal of this Institution, I shall take the liberty of adding, as a note, that that suggestion I owe entirely to Captain Dawson himself; he was one of those correspondents to whom I allude who were kind enough to assist me when I was working at this subject. That was one of the things which he suggested, a suggestion which has come from no other quarter that I am aware of, but it is a most valuable one. A table of the helm-angles of the different ships

would take its place on the bridge of the different vessels in the squadron, by the side of those tables of deviation which you and I, Sir, know so well.

He also said, when we were likely to commence war we should find that we had to make use in the Service of a large number of Officers who had not been lately serving, and who were quite ignorant of the latest ideas. (Captain Dawson: Officers who had not been serving in fleets, and were ignorant of fleet manœuvres. There are numbers of Officers who never served in a fleet). I think that seems to corroborate my view, that we ought to have a set of maxims and evolutionary data, and that kind of thing which would enable a man to learn a great deal more than merely reading over a table, or a book.

With regard to "stern fire," I do not think, as I believe some Officers do, that stern-fire is nearly, if not quite useless, but I am inclined to think the value of stern-fire, after passing through an enemy's fleet, would not be very great. I do not think it would be advisable to do much towards altering our heavily armoured ships in the stern from what they are at present. I am also very glad to see for the first time as far as I know since its introduction into the Service, that Captain Dawson spoke of the sea-torpedo as being most valuable as a defensive weapon. Ever since I arrived at any knowledge of what it really was, that has always been my opinion, that it is a *defensive*, and not an *offensive* weapon; and I think the sooner we make up our minds to that the better. If it will take the place in great measure of so many more inches of iron plating, so much the better. I had a conversation on this subject with Captain Goodenough the last time I was in London, and he made a remark which sank very deeply into my mind, and which is so valuable that I make no apology for repeating it now, and that was, although a captain may depend on the defensive value of the Harvey torpedo towed alongside as a protection against ramming, yet you are likely to meet with such an antagonist as Admiral Tegethoff, the Napoleon of the sea, as I believe him to have been, who broke through all rules,—and it would be a rule that you are not to ram a ship with torpedo towing alongside,—and when he found an enemy passing across his hawse, would ram him, torpedo or no torpedo.

Captain Dawson also mentioned a friend of his who has turned his attention to planting mangold wurtzels, and I am sure in these days, when beef costs I do not know how much a pound, and coal anything you like a ton, any man who does so deserves well of his country. At the same time I think it ought to be remembered that Rodney was what in his day was the equivalent of a retired Officer before he commanded the Fleet in the West Indies. Therefore we yet look to those Officers on the retired list to do much to uphold the honour of the Service.

You, Sir, have so exactly expressed my own opinion with regard to the stern movements that Captain Wheatley spoke of, that I do not know that I could say anything more about them. I do not know how far that invention of Captain Bremner's that was lately exhibited here might obviate anything of that sort, but still I am inclined to think it would be, to say the least of it, a very hazardous manœuvre to put sternway on your ship when an enemy with an armoured bow was 200 yards off.

You mentioned the "War-game." I hope I am in order in saying I brought the materials up here by request of yourself and of my friend Lieutenant Castle, and deposited them in the library of this Institution, where they are at present. That signal that you spoke of that exists in the French service, for going astern of another ship, is one which unfortunately we have not got in our Service. There are very many things which we may learn and have learnt from the French Navy, and I think we might also take over that with great advantage to the Service.

Note.—As I stated in my reply to the remarks of the several Officers who addressed the meeting at the conclusion of the reading of my paper, the valuable suggestion as to collecting data for evolutionary purposes from the performances of the various ships emanates from Captain Dawson, and from him alone. I regret I cannot put my hand upon the interesting letter in which he conveyed the suggestion to me, or I should take the liberty of quoting his own words.—C.A.G.B.

Captain J. G. GOODENOUGH, R.N., in the Chair.

EXTRACTS FROM THE FOUR LAST CHAPTERS OF ADMIRAL JURIEN DE LA GRAVIÈRE'S BOOK ENTITLED "LA MARINE D'AUJOURDHUI."

Admiral Ryder: It was arranged that on the termination of Captain Bridge's paper, I should read some extracts from the four last chapters of Admiral Jurien de la Gravière's work on the "Navy of to-day."* I propose, however, considering the lateness of the hour, merely to read those remarks which touch on "tactics." The paper will be printed and appear in the Journal, and I would recommend all those who are interested in knowing what so distinguished a Frenchman thinks on such a question, carefully to read it when they get their copy of the Journal in hand. The translation has been made at my request by Lieutenant Grenfell, of Her Majesty's ship "Excellent," who is the Honorary Secretary to that most useful institution, the "Junior Naval Professional Association," Portsmouth. As I was not sure that

* *Extract from the "Statesman's Year Book,"* 1873.—The French Navy is manned partly by conscription, partly by voluntary enlistment. There is an *Inscription Maritime*, on the lists of which are the names of all males of the maritime population, that is, men and youths devoted to a seafaring life from the 18th to the 50th year of age. The number of men thus inscribed fluctuates from 150,000 to 180,000. Though all are liable to serve, the Government, as a rule, dispenses with men over 40, under 20, as well as pilots, Captains, the fathers of large families, and able seamen who have signed for long voyages. The term of service in the Navy is the same as that in the Army, with similar conditions as to Reserve duties, furloughs, and leave of absence for lengthened periods. It is enacted by the law of 1872, that a certain number of young men liable to service in the active army may select instead the naval service if recognized fit for the duties, even if not enrolled in the *Inscription Maritime.*

For administrative purposes France is divided into five *divisions maritimes,* and subdivided into twelve *arrondissements,* as follows:—

Divisions.	*Arrondissements.*
1. Cherbourg.	Dunkerque, Le Havre.
2. Brest.	Brest, St. Seroav.
3. Lorient.	Lorient, Nantes.
4. Rochefort.	Rochefort, Bordeaux, Bayonne.
5. Toulon.	Marseilles, Toulon, Ajaccio.

At the head of the Administrative Government of each maritime division is a Vice-Admiral, bearing the title of "Préfet Maritime."

It is estimated that there are in the *Inscription Maritime* over 50,000 men!! between the ages of 25 and 50 who have performed *over six years' service in the Navy!!* and are available in case of war. The Royal Naval Reserve in England has been allowed to dwindle down to about 12,000 men, who are drilled for one month each year, but not more than 6,000 are supposed to be in England at the same time. The Royal Naval Coast Volunteers are almost extinct; the Coast Guard numbers about 4,000 men; so that on war breaking out we should have only a Reserve of 10,000 men immediately available, one-fifth of the numbers available in France. Ships in which to embark these men would of course be required, but the late American war taught us how a navy could be promptly improvised.

Lieutenant Grenfell's professional duties would allow him leisure to complete the translation, I requested Mr. Stock, the French Master of the "Worcester" training ship to make a translation also, which he was good enough to do. The translation I am about to read is that of Lieutenant Grenfell, whose acquaintance with the technical terms used leaves nothing to be desired.

Chapter XIII.

Classification of the Fleet—Creation of Special Corps.

Ships no longer grow old on their building slips; they leave them now-a-days to receive their engines as soon as the hull is finished. By this arrangement the loss by waste of material is considerably increased; and if a certain number of ships were not annually built, at the end of eighteen or twenty years the fleet would have entirely disappeared. Moreover, to assure its existence for this length of time, the greatest care must be taken in its preservation.

A budget which aims at preventing decrease in the *matériel* of a fleet must estimate not only for the cost of these new constructions, but must also, side by side with this fund, devote another special one to its preservation in good order. Two or three additional ships could be built every year were it not for the great cost of the maintenance and occasional complete refit, as well as of the mass of minor repairs, of those already constructed.

It is easy to imagine the embarrassment with which the Minister of Marine, at the close of the Crimean war, must have seen the arrival in port of all those vessels which, though he was obliged to disarm, he could not leave to perish entirely. Machinery does not the less need the services of an engineer, after it has temporarily ceased its active duties, for he alone can take charge of, clean, and preserve so much dormant national property. The traditional shipkeeper who sufficed for sailing ships would ill preserve the delicate machinery of a steamship; for while too long a repose would rust the different joints and bearings, there would be great risk of fracture or of destroying the true working of the various parts if they were set in motion by an unskilful hand.

The first care of Admiral Hamelin was to place these treasures under the superintendence of a staff which, though small, was sufficient to guarantee them from too rapid a decay. For the condition of complete disarmament he substituted an intermediate one to which he sought to give the name of "reserve." This fleet, which preserved the most important members of its crews, was a reserve in every sense of the term, for each ship had only to complete its complement of men and Officers, and to fill up with powder and provisions, to be at once ready to put to sea; but when the Minister came to estimate the cost which such a system of reserve would demand, he recoiled before its enormity. Complaints were also made by the northern ports that the maintenance of a too advanced state of preparation would expose the fleet to the danger of having to put to sea with machinery already

half-used, and which would be in a far worse condition than if it had been carefully protected in store. Under a southern sky, however, these difficulties did not exist, Toulon raising no objection to the condition of immediate readiness.

The decision finally taken by the Minister of Marine was to divide the reserve fleet into a sufficient number of classes to satisfy the wants of the moment and the various demands of the different seaports.

In the old Navy there were but two conditions: "In commission," and "Dismantled." For the new were introduced, "Preparing for commission;" "Harbour commission;"* "Fitted out for anchoring in the roadstead;"† "Half manned;" and lastly, "Fully commissioned."

"Half manned" answers to that state—unknown hitherto in the life of a ship—which now-a-days always precedes her entry into the ranks of the seagoing fleet, viz., when she is undergoing her various trials.

Adjusting the machinery of a ship requires from five to six months' work, during which time she may remain in a state of "preparing for commission," that is to say, having on board a staff which superintends but does not take any active part in the trials, and a crew whose only duty is to prepare her for leaving port; but as soon as all the machinery is fixed, the contractor impatiently demands repayment of his expenses; these demands it is impossible to satisfy until completely enlightened as to the value of the engines delivered; thus it is that, notwithstanding financial difficulties and the desire on the part of the Minister of Marine of diminishing the cost of commissioning the ship, she must nevertheless be more or less manned, and sent to test her engines at sea.

It will be sufficient to half-man her for these trials so long as she has her full complement of engineers and stokers. A Minister of Marine has thus three fleets constantly on his hands: one seagoing, another in reserve, and the third under trial; this last, owing to the uncertain result of experiments, to repairing and retouching, and consequently the frequent use of docks and basins, is incontestably the most likely to disarrange the estimates.

The fixing of a naval budget is very far from being an exact mathematical operation; a very large amount ought to be allotted to miscalculations. It is, however, very important that the figures should not be arranged at the expense of the construction of new ships, as there is always a temptation to do. Candour is not only the first duty of a Minister, but is also his wisest course, as it is impossible to mystify others in the budget without to some extent mystifying oneself.

The organisation of the *matériel* had been a work of at least five years. Admiral Hamelin solved this question in a manner which appeared to satisfy, and in fact did satisfy, every necessity. The preservation of the fleet in good working order was assured, and, not less important, harmonious working between the central administration and the seaports, was obtained. A single word sufficed to indicate the designs of the Minister, and to say all that was necessary with regard to the authorised expenditure and the prescribed pre-

* Commission de port. † Disponibilité de rade.

parations. It was a happy mixture of simplicity and economy to which nothing was wanting.

Nevertheless this was only a minor point, the really important question being the constitution of the *personnel* of the fleet.

Admitting that we possess the ship, no maritime nation can flatter itself in being able to man it so quickly as we can. The "Inscription Maritime" is a force which is always at hand, a reserve which itself preserves its ranks at full strength, while the very trade by which its members live, preserves them in full vigour and efficiency without need of training. It has its first and second classes of reserve, namely, the men of the first and second levies. One portion of this population, which lives by the coast fisheries, is always to be found on the coast; the other is employed on distant voyages. It is possible that this latter might be compromised by a very sudden declaration of war, if the fishermen were not at hand to supply the first armament, which ought to secure its return.

No resource has ever been more precious, and—if I may say so—none better managed. It is only too easy to rely too much upon it, and we have severely tested it at times; luckily this is not our only reserve, for we can apply to the same source as the Army for the third of our effective strength. Thus we have found that men have never been wanting whenever it has been necessary to rapidly pass from a peace to a war footing. A number of men do not, however, alone constitute a crew; if, as seems reasonable, we take for the basis upon which we should allot a complement to a ship, the *rôle* she will have to fulfil in action, it will be seen that it is indispensable to provide beforehand for certain special duties. A large extension was given to the system which was established by the Government of July of forming a school afloat for seamen-gunners; it was sought to have for each of these duties, men specially prepared by technical instruction, and furnished, like the seamen-gunners, with a certificate of efficiency. Thus to the port of Lorient was allotted the task of furnishing the fleet with men acquainted with the field exercises, while, in addition to training captains of guns, instruction for a certain number of youths in the use and application of signals, as well as of the helm and lead, was established at Toulon.

The creation of these two special corps was an admirable measure. To realise his idea, it had been sufficient for the Admiral to reproduce, with but some slight and insignificant changes, an institution already vigorous; but to assure the easy recruiting and constant supply of the various elements of the engineer staff was no easy matter. Though a text-book was authorized, six monthly courses established and thrown open to candidates of all grades, and appeal made to the industrial schools as well as to schools in the seaports, the scheme remained incomplete.

Frequently as a solution to this difficulty has been sought, the solution is still wanting. In truth, it is no less a question than that of creating a Navy within the Navy.

The *rôle* of engineer will not remain much longer a subordinate one; if the ranks of the other Officers of the ship do not speedily open to

them, the corps of Naval Engineers will forcibly create a position for themselves out of their own. No other solution will suffice.

I have reviewed in succession the different elements which compose a ship's company: the seamen gunners, the small-arm men, the helmsmen, and the engineers. I have only omitted those men charged with duties aloft, those sailors *par excellence* so honoured hitherto by the name of topmen. It was thought—very wrongly, I think—that we should be able to get them from the Merchant Navy sufficiently licked into shape, and that we could then complete their education during a cruize or two, as well as that of the *deck-hands.* The *deck-hand* is the main working unit of a ship's company; at times we see him on a yard furling a sail, again with a musket on his shoulder, or straining at an oar; while he is equally ready with a tackle-fall, hair broom, or a gun-handspike. The advance of mechanical appliances will eventually give him some time to himself; at present he has none, his *specialité* being to lend a hand to everything that is going on.

The decree of the 5th June, 1856, was one of those regulations which would have lasted a century in the days of Colbert or M. de Choiseul, for it guaranteed us good materials for our crews, leaving us only to find the cement to keep them together.

But here, perhaps, the desire of hastening and facilitating the manning of ships was carried a step too far. By sacrificing the cohesion of a crew, one great motive of emulation was lost. As provision for the rapid formation of a crew was alone made, on paying off it was allowed to disperse and scatter to the four winds of heaven.

This arrangement, which suddenly separates old comrades, old "chums," accustomed to undergo together the trials and privations of the Service, and equally proud and concerned in supporting the good name of their ship, is a most vicious one, to which a remedy must be found. We had, under the first Empire, regular 'man-of-war' crews —in other words, naval regiments, and during the last years of the Restoration, Permanent Divisions, but the Decree of 1857 allows of no other permanency than that of those officers and petty officers who are on the roster for sea service. All the others are subject to be discharged and completely dispersed.

Our naval barracks, no longer occupied by the Permanent Divisions, afforded a depôt for the special classes—a sort of reservoir, where the authorities sought for each ship commissioning the necessary number of gunners, riflemen, helmsmen, engineers, and deck-hands. Though I am unable to thoroughly approve of a system against which I have already made known my objections, it is impossible to deny that with these three institutions—the Reserve Fleet, Depôts for Special Corps, and the "*Inscription Maritime*," the Empire solved, in the most complete and economical manner, the problem of prompt mobilisation.

Though from 1858 to 1870 the Navy has many times been taken unexpectedly, at one time being asked to transport armies of 25,000 to 30,000 men across the high seas, at another, being required to have all its forces ready at a few days' notice, yet it has never been appealed to in vain. The rapidity with which those orders have been executed has excited the astonishment of foreign nations. Of all the great

powers of the State, the Navy is perhaps that one which has least deceived expectation. Though it is true that we have not had to undergo a naval war, at the same time we must never forget that, if France seeks to maintain her rank in the world, if her alliance is again one day to be sought for, it is always this crucial test of a maritime war which she must keep in view; and it is strictly with a view to obtaining the advantage in such a war that the constitution of her fleet must be arranged.

Chapter XIV.

The Uses of a Navy.—Considerations on Naval Matériel.

What is the use of a Navy?—is the first and most difficult question which a statesman in the present embarrassed state of the finances should ask himself.

My answer is given unhesitatingly—To occupy and maintain the great ocean highways.

The occupation of the seas, though it were only temporary, ought to have consequences of the very deepest importance, even in a purely continental war. It was thus that the Federal States of America triumphed over the resistance of the Southern States; it was thus that England eventually exhausted the resources of the first Empire; it was thus in the Crimea that we conquered Russia. The damage done to American commerce by a few privateers has been greatly exaggerated, and the capture of a French merchantman by a German corvette issuing in the depth of winter from an inaccessible and no longer blockaded port, has caused the most absurd sensation. A naval supremacy, however well established, can never entirely prevent depredations of this nature; at sea, as on shore, the convoys of a victorious force are never absolutely secure from attack. But what results can flow from these comparatively insignificant successes? Is it to be imagined that the bold deeds of twenty "Alabamas" could have delayed the fall of Richmond for a single day? If it is from a reliance on such facts that the paying off of our squadrons is demanded, and a mere predatory and privateering warfare prescribed, I, for my part, would ask the advocates for such a course to consider for a moment the following hypothetical case:—The French armies are again massed on the banks of the Rhine, while every sea is furrowed by the keels of our countless frigates and corvettes; but before our ports, cruises a German fleet, to which we have no fleet to oppose.

What would follow from such a state of things? All our coasts would be kept in constant alarm, all our ports would be asking for garrisons, and the whole of our maritime population would be exposed to falling into the enemy's hands. It has always been the cruel destiny of the crews of privateers to finish their adventurous career in the hulks, and by privateers I mean equally ships of war specially designed for cruising and those vessels which are equipped by private speculation. In the war of 1778, we saw our isolated cruisers succumb, one after another, the very day the high seas were momentarily abandoned to the English

squadrons. We ought in fact to look upon squadrons as so many moveable fortresses able to send forth their flying columns in comparative security to scour the surrounding districts. I am of opinion that before this predatory warfare could be set on foot, it would be necessary to sweep the seas. So long as the *broom* of Van Tromp remained at his main-mast head, the merchants of Amsterdam and Flushing were without fear; they knew well that their losses, should they experience any, would be light.

I do not deny that this predatory warfare may be the sole refuge of the weakest side. The moment the disproportion of the two forces has become too great, it may be well to disperse in order to reduce the chance of capture; but to accept this programme *à priori*, without knowing exactly which is the adversary fate is reserving for us, would be to foolishly abdicate our naval position in virtue of a force which is not yet in existence. What figure should we cut in the Mediterranean, for instance, if we gave up our squadrons in those waters? Shall we let it become an Italian or a Spanish lake, when we would not allow it to be a Russian one?

Unless fate gives us England for an adversary, we ought to be prepared to undertake *la grande guerre* at sea. Even against England herself, this line of action would be necessary on the very day that new complications modified the number and nature of our allies. It is from this basis, then, that I always consider any plea for the maintenance of our fleet.

Under the Empire, our war-fleet was a homogeneous fleet; each of the ships which composed it could turn in nearly the same circle. As long as ramming remains for our vessels the grand mode of attack, naval actions will inevitably be mere *mêlées*. It is, above all, necessary in *mêlées* to have ships which describe circles to all intents similar. At the same time I am far from thinking it impossible to reconcile the advantages to be derived from the progressive researches of science, with those which result from uniformity in construction. In a squadron, two or three ships working together form the tactical unit; in a large naval force, it is the squadron which becomes the unit, that is to say, a group composed of six ships at least, of twelve at most. Each squadron ought to manœuvre separately and independently, in such a manner as to achieve the result indicated by the orders of the Commander-in-Chief.

The homogeneity of the fleet can thus be given up, so long as that of each squadron be preserved. This programme will, no doubt, appear very limited to those who find fault with our naval architects for their timidity and lack of enterprise. Happily, we have other designs under trial than these costly constructions which form our first-class fighting ships. It is not now-a-days necessary to restrict in any particular those vessels which are not the equivalents of our old line-of-battle ships, save to some conditions of strength and speed; for they belong beforehand to no particular type, and each should be an individual design franked and guaranteed by its author. It is to this domain that I would direct the inventive boldness of our naval constructors.

Our progress in naval architecture has hitherto proceeded rather by

impulses than by any continued effort; from 1852 to 1857 the leap was enormous. All our youth was passed in fierce debates, in which theory and practice were ever at variance, when a young man appeared on the scene, who both loved our profession and had its true instinct. Him we took and raised above the rivalry, criticism, and barriers which opposed him on every side. His very first creation was a masterpiece. The productions of his original and fertile mind were called successively the "Napoléon," "Algesiras," "Gloire," "Solferino," "Océan." To him we owe the whole of that Navy of which we are so justly proud. This fleet is homogeneous, because it sprang fully armed like Minerva from a single brain. It is time that a new inspiration manifested itself; the same type is reproduced too often with modifications which indicate ingenuity of arrangement rather than fertility of design. We wait for a new "Algesiras," in other words, one of those ships whose appearance is at once a great event and a vast acquisition of strength. In the "Algesiras" it was not so much the ship herself which was the novelty, as her engines. In the merchant Navy less attention is paid than in ours to the external appearance of the machinery, and more to the results to be obtained from it. There is much to learn from those long voyages where extreme speed is maintained sometimes for weeks, and passages accomplished with a regularity which is rarely interrupted. When our ships of war are able to cross the Atlantic in company with any of our great mail steamers, they may easily dispense with the other trials which they now undergo. The science of the naval architect is, now-a-days, exceedingly complex; we are far removed from the days when builders handed down to each other the simple secrets of an hereditary art. In the architect, the engineer now-a-days rivals the ship-builder—I should say, surpasses him, for this faculty is by far the most rare and most necessary of the two. By study it is possible to become a builder, but one must be born an engineer.

The Administration—let it be well noted—is not generally so hostile to progress as is said or supposed; its extreme caution, which keeps it somewhat behind the times, is the result of that pitiless criticism which public opinion lavishes on all which is not on first trial an undoubted success. Could it obtain a little indulgence, the Administration would not view novelties with so much suspicion. What public opinion should do—if I may use the expression—is, give strength to the budget and wings to genius. We ought more than ever to aim at perfection in our constructions since we are certainly menaced with a reduction in the number of our ships. The question of pay is insignificant compared to that of the general expenditure of stores and the salaries of workmen. It is to the estimates for the *matériel* of the fleet that we must turn if we wish to economise seriously; but at the same time we must thoroughly realise what these economies are, which is not so easy as we might suppose. It is impossible on any given day to discharge the large population which lives on the work obtained in our building-slips. While we can economise in the matter of these expenses there are others in which it is impossible to cut down anything.

In fact, reductions should never be undertaken unless the principles on which they are to be regulated are thoroughly understood. I have

never had any doubt in my own mind about these principles; whenever it is a question of sacrificing either our dockyards or our fleet, the former, I affirm, must always give way. These grand monuments of our greatness must, I think, be sacrificed to preserve our ships; our national pride must submit to it. What matter if we display less magnificence to strangers, if we can confront an enemy with forces not sensibly diminished? This is the result to which we must aim.

I think I have already sufficiently indicated how, as far as the "*matériel*" of the fleet is concerned, we may still maintain our warlike condition; but in so doing I have only attacked the least important part of the question. The real point, as no one doubts, is that which concerns the living organism of the fleet; it is here, unquestionably, that a judicious and conservative scheme is required. I shall describe briefly one which I have conceived, at the same time I confess that I have sometimes exceeded my own programme. Although this is no time for too exalted views, I could not forbear from seeking to improve and perfect those institutions whose maintenance I have persistently demanded.

Chapter XV.

Constitution of the "Personnel" of a Fleet. The Officers and Men.

The real strength of any military organisation is measured by its effective force in officers and men.

This may, perhaps, be called a truism, though it is not the less important to be occasionally reminded of it. If I was not certain that the officers of the fleet will meet with respectful consideration, and that the hardly less valuable class of petty officers will be equally well treated, I should have but little hope in endeavouring to discover the future of the French Navy, for in a very short time our Navy would cease to exist; the zeal of Commissioners of Finance causes me but little anxiety on this point.

I wish I could speak with equal confidence of the proposals of our reformers; I fear certain schemes which appear to me stamped, I confess, with a peculiar imprudence. Among these I may mention one which aims at suppressing the training-ship which for nearly forty years has supplied us with all our officers. It is impossible, no doubt, that the Navy should completely escape from those reforms which will result from a considerable modification in our social system, but it would be curious if endeavour was made to pass it through most dangerous experiments just when its praises are in every mouth, and when it possesses a greater share than ever of public estimation.

I admit, perhaps, the necessity for a *free* training for officers, but I cannot understand how they can entirely do without training. It would be equally dangerous to apply serious modifications to our existing mode of recruiting our ships' companies. By the introduction of forced military service for all, the duration of which is to be divided into two or three distinct periods, every one in France will have to submit to the hitherto exceptional *régime* under which—not indeed

since Colbert, but since the latter years of the Government of July—the whole of our sea-faring population has lived.

If the "*Inscription Maritime*," such as the last decrees made it, continues to exist in some particulars as an exceptional *régime*, it will be due far more to the privileges it authorises than to the cost it imposes. I am unable to see what inconvenience would arise if that interesting class, which has such great claims on the State, continued to enjoy its privileges for some few years more. For many years it has been placed under the Admiralty, a guardianship it should not be deprived of too suddenly; the high degree of discipline to be found among French sailors is due to this constant though hardly visible attachment, a bond which could not be broken without the most serious disturbances being at once produced in our Service. A nomadic Navy, like that of the United States, would be the result. France would lose those devoted sons who exist along her coasts, those sailors, fashioned to obedience and discipline from their earliest days, who regard their native country with affection as the home of their declining years.

For these reasons I still look to the "*Inscription Maritime*" for producing the main portion of our crews, and to our training ships for giving that theoretical instruction to our young officers, which is essential for a sailor of the present day. Our profession, as I have already said, and not without some slight regret, was formerly an instinct, it is now a science. Let us work, then; let us work incessantly, since success is now-a-days the reward of labour alone. However limited our budget may be, I would still devote the greater portion of it to the instruction of our officers and men. The Navy has hitherto been most frequently employed on entirely imaginary duties; stationed to protect a commerce which often never existed, or on diplomatic service, where the chief difficulty lay in unravelling complications which it had itself produced. The only essentials of a peace armament are, in my opinion, those which conduce to the rapid formation of a war armament. Naval stations are not only useless, they are positively cruel. Three or four of the best years in a young man's life are devoted to an enforced absence in an unhealthy climate. A remedy for this has been proposed in constant circulation; it is the general wish of the Navy, to which I give my unqualified adherence. I make but one demand; that among all these ships constantly circumnavigating the globe, there should be one specially detailed for providing the fleet with properly certificated topmen. It is difficult to understand why, when all other classes have been deemed worthy of special training, the most important branch of all should have remained uncared for. The topman will always be the most intrepid and most intelligent man in the ship. The chief boatswain's mate* is incontestibly superior to all the other petty officers; it is to him, and not to the chief gunner's mate,† or chief-quartermaster,‡ that the regulations give the command in case all the officers are removed. The class of topmen is the nursery for these chief boatswain's mates. We see, then, that both justice and foresight counsel us to surround the recruiting of

* Maître de manœuvre. † Maître canonnier. ‡ Chef de timonerie.

this precious class with all those guarantees which assure the effectual discharge of duties in other branches of the Service.

The task of developing the child into the man has ever been considered a difficult one by philosophers. To make an officer out of a cadet does not demand less care. Supposing that one of these young scholars who leave the training ship sufficiently acquainted with the elements of their profession, was confided to my care, and that I was charged with training him for the rank of lieutenant in the most thorough manner, this is how I should set to work. He should make, first of all, two or three trips round the world. These voyages would "sailorize" him, without making him a thorough sailor. Should there be a certificate for seamanship, as there is for gunnery, musketry, and engineering, it should only be given to those who combine knowledge of pilotage with knowledge of handling a ship. It has always been my belief that the course of instruction will be incomplete until pilotage is taught as well as seamanship and gunnery. Training in this subject should be conducted where all the difficulties of navigation are united. From Bayonne to Dunkerque we find at once fogs, currents, and shoals; it is there our young officers and our quartermasters should be taken. The latter would there learn to watch the course of the vessel with more attention and intelligence; into whatever waters chance should take them, they would soon be most useful auxiliaries to pilots; while the former would soon have sufficient skill to do without pilots altogether.

Five or six years well laid out would give a young officer an amount of instruction of which he would feel the advantage all his lifetime. Before entering the higher ranks, he should be called upon to pass through the various schools which have been instituted for the different classes of which our crews are composed. He should become a rifleman at Lorient, a gunner at Toulon, an engineer at Brest and Indret. Having arrived at the rank of Lieutenant he would be ripe for the grand school of all, where all the acquirements and experiences of a young officer's education are put into practice; I mean the evolutionary squadron. This squadron, which was organised in 1825 by M. de Clermont-Tonnerre in the West Indies, and since that time has assembled nearly every year in the Mediterranean, is the source where all our officers and men from time to time renew their warlike spirit.

Even if this were its only advantage, the evolutionary squadron ought to be preserved at all hazards; but a consideration still more important, if it be possible, imperiously commands its maintenance. It is our only school of tactics.

The fleet which has the greatest acquaintance with tactical manœuvres will possess a great element of success in the day of battle.

When two fleets meet at sea, when the two lines, after hurling one against the other have been mutually penetrated, the action can only be continued by immediately reversing the course previously taken. This manœuvre, which will be almost inevitable, is of such a nature as to cause more than one involuntary collision between ships of the same fleet; the homogeneous composition of the fleet and similarity in their circles of turning will diminish these risks; skill in combined

movements will make them disappear altogether. It is not in the practice of *regular* evolutions and in the execution of geometric figures that proof is given of a trained and skilful eye. The practice which can alone develop the nerve required for most of the manœuvres which will be carried out on the day of actual combat is very different. Neither isolated cruises, nor the endeavouring to represent squadrons by a collection of despatch vessels and gunboats provide a sufficient school for this most difficult art. An Officer must learn how to handle in a very small space, masses of 6,000 to 7,000 tons, which cannot come into collision without mutual destruction; he must nerve himself to behold unmoved the imminency of the most terrible catastrophes; he must be accustomed to preserve a close-order both day and night; to know how to group, how to spread out, sometimes presenting a compact mass, at others, successive échelons; he must possess, above all things, the indispensable art of divining the intentions of his Commander-in-Chief, and by watching intently his slightest change of course, at once to comprehend and conform to his movements so as to be independent of his signals. *This is the whole secret of Naval tactics.*

There is but one definition for this word "tactics:" it is the art of sustaining the fight, and of not falling foul of each other. The most skilful are those who are able to combine their efforts even when the regular transmission of orders has become impossible. The very last economy France ought, in my opinion, to make, is that of giving up the evolutionary squadron. The day when the condition of our finances forbids us the maintenance of such a force, it will be necessary that at least every year an instruction-cruise — should its duration be only one month—be undertaken to prevent the total loss of those precious traditions which we owe to fifty years of toil. With a diminished armament, neither the period of service of the officers, nor the commands, can be of such long duration as hitherto.

If it be admitted, as I have endeavoured to show, that in time of peace but a very small display of force is necessary, and that the chief object of a naval armament is to instruct and train all those various elements which we shall need in the day of battle; then we shall naturally seek such an arrangement as will most widely extend instruction through the entire body of the Navy. This arrangement is to me self-evident; we must increase the number of cruises, and shorten their duration.

We have recently discovered among our blue-jackets aptitudes of which formerly we doubted; while admitting that they were good gunners no one believed that they would ever make more than indifferent soldiers. Though one of those who hold that we should never lose sight of our own proper profession, and though I should regret to see seamen neglect their proper and traditional sphere of action to become an auxiliary branch of the Army, I have not the less constantly protested against the views of those who would discourage our ever disembarking our men. I am very glad that events have shown what these landing-parties can be; the action of our fleets on an enemy's coast will become far more efficacious. Would it not be very

lamentable if the 5,000 or 6,000 picked men on board a squadron were not always ready, without further assistance, to execute a *reconnaissance*, a *coup de main*, or a descent on an enemy's coast? Every considerable assemblage of ships should be able to forthwith furnish troops sufficient to undertake any of the minor operations of warfare. I have long since discussed this question with young officers who will one day have to realize it, and I have never ceased to demand that the number of small-arms allowed to each ship should be considerably increased, companies for landing provided with those materials for encamping without which it would be impossible to leave the seacoast, and that a section, provided with the necessary tools for throwing up an earthwork or clearing away an obstacle, should always accompany our riflemen and mountain artillery. That which the Roman fleets and the Norman invasions were able to accomplish, our squadrons, when once they had swept the seas, should be in a position to attempt. When every ironclad shall carry on her sides seven or eight steamboats, which I think is indispensable, no squadron will appear on an enemy's coast without spreading alarm and causing a vast amount of destruction.

It would be superfluous to insist upon this view of the matter; a complete transformation in our social system will be due to the misfortunes we have just gone through. Every Frenchman is about to become a soldier. Those hopes, which I formed less than a year ago without concealing from myself the great difficulties which might defer their realization, will be accomplished if the Navy is only allowed to follow the natural tendency of events in the present day.

Many people will be astonished to see me develop with such calm confidence a programme which breathes so little discouragement; more than once my friends have rallied me upon what they are pleased to term my "robust hopes." We shall see whether the future will prove them or me to be right.

Struck by a mortal blow Charles XII carried, it is said, his hand to the hilt of his sword. Shall we, for a wound less deep than many we have often inflicted on other nations, resign all hope, and despair of the future of France? What may become of the organisation of the Army during the critical phase through which we are passing, I cannot say; but I think I can confidently state what that of our Navy ought to be in the present day.

Chapter XVI.

The Fleet of the Future.—Institutions which are absolutely essential.

To gain our point, it is by no means indifferent from what conditions we start; the very best reasoning will only lead to a false conclusion unless the premises are sound.

What is the principle on which the organisation of our fleet should be based? On that principle which was true in all time and which is an hundred times more true to-day—neither Colonies nor Dockyards make a Navy, but *Ships*. The Colonies must seek elsewhere than in our budget the means for squaring their expenses; the

Dockyard must lose the opinion of its own greatness, and be content to become the very humble slave of the Ship. "We all, while we are "here," said Admiral Lalande in 1837, then Superintendent at Brest, "are but the servants of the servants of God. Our resources, we only "accumulate to dispense to those who will have to make use of them; "a seaport must never be judged by its workshops or stores, but by "the ships it fits out." This is wise language, containing in its brevity a complete system. In order that those passions that are so natural to the heart of man should not prevent its accomplishment, I could wish that history never related a naval action without saying—"the ships which have fought were built by such a Naval Architect, equipped by such a Maritime Préfet, and commanded by such an Admiral."

As for the Minister, all success ought to redound to his glory; when an operation is successful, it is unquestionably he who should be first rewarded. The victor is but his emissary and his debtor. Why does public opinion hasten to consider him as a rival? Mean competition which, though it does not breed a refusal of active support, still embitters the mind and alarms patriotism! He who is occupied with the work of organisation is frequently tempted to envy the luck of those nations who have everything to create, and have not to clear away those obstacles with which time has obstructed our path. It needs but so little money to procure a fleet, and so very much may be spent on a Navy of long standing, without in the end being certain of possessing one! For the sum which two years of our old estimates would have given us, the fleet which the Empire left us could be built. This fleet, it is true, would last barely twenty years. It would be necessary thus in twenty years to have put by the value of another such fleet. This sinking fund, which is gradually expended on the annual constructions, instead of being accumulated in the coffers of the State, constitutes the main part of that which is called the normal expenditure. It is impossible to make any retrenchment in this sum, unless we consent to a rapid decay of our naval power; but, in my opinion, saving would be effected without loss of strength if we confined ourselves to merely preserving in good working order the whole of our transport fleet, instead of renewing it. If we are seeking for economies, this is one which will cost us but little in point of actual strength.

I believe I can indicate another, whose importance will readily be recognized. The annual sum for new constructions depends on the rapidity with which materials decay. The amount of this sum will be considerably reduced, if, in future constructions, wood is replaced by iron. It is true that this substitution will necessitate the purchase of new apparatus, that our stores of oak will be no longer of service, and that the mass of our carpenters will have to be discharged. The scheme is thus not so simple as it appears at first sight. It is a reform to be made, but one to be made with extreme caution. As for the workshops, basins, and all that fleet of stone, which, made for producing and preserving the fleet of wood and iron, for the most part devours it, its further development must be arrested, and we must content ourselves with allowing it a sum sufficient to maintain it in its present condition. On an annual credit of 65 millions, economies in

matériel ought to furnish us the means of saving those institutions whose defence I have undertaken.

The separation of the Admiralty and the Colonial Office* will also assist us. I should not propose to create, as in 1857, another portfolio; the Chamber of Commerce will undertake the administration of interests which are rather commercial than maritime. As for the Colonial garrisons they properly belong to the War Department. This little Army, which has always been increasing, has everything to gain by being absorbed into the great national Army. The services it has rendered, and the bravery it has shewn, ought to procure it this honour. While a mere pendant to the Navy it would still have continued to vegetate as an auxiliary corps. A far wider field must be opened to it, and the occasion seized, which we let slip fifteen years ago, of simplifying the arrangement of our Naval budget. We must still have Officers to build, to command, and to man our ships; doctors to tend, and chaplains to instruct and minister to our crews, and there must be no reduction made in these essential branches, whether civil or military, of our Service. The pay which they get is but a drop in the ocean of the Naval Estimates. For the cost of one ironclad frigate, we could afford to double, almost to triple the number of our Officers. M. Hyde de Neuville, who perhaps more than any Minister understood and defended the great interests confided to him, gave utterance during the Restoration to a saying, which is worthy of deep consideration, "We must economize in *things*, never in *men*." If it were possible to impose silence for a moment on the jealousies of the human heart, and to go with an unprejudiced mind to the root of the matter, it would be seen that never was a truth so incontestable. It is possible to ruin many a life, to totally destroy the organisation of a great Service, without realizing by such ill-considered retrenchment, the decrease in expenditure which would be represented by the coal which it is sometimes so easy to save.

I most earnestly demand that no reduction be made in the number of the ships which we ought to be able to place in line of battle. But what purpose would the fleet serve if the *personnel*, without which our men-of-war are but useless toys, is to be disorganised? "The fleet," I shall be told, "will not be reduced, only the number of ships kept in commission in peace-time. Many of your Officers will find themselves without employment. It is not only their zeal which will suffer from such enforced inactivity, but still more so, their professional knowledge. A Naval Officer is not formed in barracks, nor in harbour, but at sea." A remedy for this state of things is easily found, and was applied during the first years of the Restoration; England and the United States have had recourse to it: An Officer must be permitted to serve on board merchant ships—on board private ships, is what the regulation of Louis XVIII says—without any loss of position. To me it only seems fair that he should not lose those claims to promotion which his seniority would give him. If we here apply the principle of renewing leave of absence, a reserve

* Now combined under one adminstration.—Trans.

of Officers will be assured almost without expense, as the "*Inscription Maritime*" has assured one of seamen. In the last thirty years I have seen several of those ideas which I ardently propagated, both patronised by public opinion, and adopted by the Admiralty. During these thirty years my opinions have been modified, though never falsified, by the course of events and the revolutions achieved by science. I find them in 1872 but little altered from what they were in 1842 and in 1859.* No doubt there are some on which, if needs must, I could accept some modification; but on those which appear to me fundamental, neither the misfortunes of the present day nor the mania for change, could gain from me the slightest alteration. I pronounced in a previous chapter the words "*Institutions Necessaires.*" These institutions I enumerate again. The first is incontestably the "*Inscription Maritime;*" the second, our system of separate schools for special subjects, to which must be added a school for topmen, and one for pilotage; the third is called the evolutionary squadron. Save these institutions and you will save the Navy.

If our Naval power was not situated on two seas very far apart, I should prefer having our central administration placed in one of our sea-ports rather than at Paris. I have long held this opinion. The river of time which hurries everything onward in its course does not spare the best thinking powers of a sailor. After having drunk for some years of these waters of Lethe, the sense of the deep needs of our Navy becomes less keen; other matters occupy our minds and engross our attention; little by little we sink under the moral stupor which invades us. The deserted fleet drifts hither and thither at the will of the waves, and we run the risk of only finding it again when it is among the breakers. Since a Minister of Marine can neither live at Brest nor Toulon, he should at least go frequently to both places; this, while reviving his zeal, will excite that of his subordinates. He should be seen everywhere, coming unexpectedly without pomp or excitement, in our dockyards where his presence would instil fresh life, at the trials of new ships, and on board our training ships in the midst of officers and men. These inspections could not be made too frequently; the work would be better carried on, and progress would be more real. There are few questions which would not be better solved if they were studied on the spot, whether by the Minister in person, or by the members of the Admiralty Board,† or by those of the Constructor's department.‡

How many contradictory orders and unfinished undertakings should we not be spared! As for business, the very worst way of carrying it on is by telegraph. With its oracular obscurity this mysterious wire is the most hateful instrument that an Administration ever used. By it, honest work has given way to undue haste, well-digested orders and explanations to feverish dialogues. It is impossible for one man to see and do everything himself; it is by far the wisest plan to repose

* See the author's "De l'Organisation Militaire de la Marine." (Extracts from "Guerres Maritimes" and "Souvenirs d'un Amiral)."

† Conseil d'Amirauté.—Trans.

‡ Conseil des Travaux.—Trans.

complete trust in those who see and those who perform. For a Minister, as for a Commander-in-Chief, or a King, the secret of governing is to know how to decide.

Hitherto I have been occupied with conservative schemes alone; it must, however, be thoroughly understood that if we make too sudden a halt we shall soon find ourselves left behind. Stagnation in these days is the very worst imprudence. Everything is advancing, ships, guns, engines, everything—even powder.

The practice-grounds, the great factories belonging to the State or subventioned by it, are also necessary institutions; nevertheless, much cost might be spared if we knew how to profit by those studies which other nations undertake. It is absurd to endeavour to experimentally determine every point for ourselves, and to seek from purely speculative researches what is after all only a trade-secret.

The Russian Navy sets us a very good example on this point. Russian officers are seen everywhere, and prove themselves to be, as a rule, very judicious observers. Very little of interest occurs in the naval world without their becoming immediately acquainted with it. The battle of Lissa was hardly fought, than one of their Admirals hastened to Ancona to examine the ships and question the officers and men who had taken part in it. We travel too little; we are neither acquainted with foreign ports nor foreign dockyards, while ours are constantly being visited by intelligent travellers. A special fund ought to provide for those doubly fruitful missions.

I repeat it; what our Navy has done in the last fifty years is nothing to what it will have to do in the event of a naval war. I have very often sketched in my mind the constitution of a fleet which could at any given moment unite its scattered fragments, and concentrate formidable masses on two or three previously chosen points. I asked myself how our institutions, our budget, and the distribution of our forces could be made to contribute to carrying out this idea. I revived on a larger scale the plan of 1805, convinced that the fleet which can most promptly concentrate, ought to be able to keep for several months the advantage gained in the first few days; for the return of its scattered seamen would be assured and those of the enemy intercepted; but it is impossible to undertake such operations if the fleet be not accompanied by a complete train of store and provision ships. We have constructed transports for troops and horses; these might be got rid of without great inconvenience; what we want are transports for provisions, and, above all, for coals. These latter will be of a type quite novel and very difficult to construct. Mixed transports of inferior speed will be nearly useless. The transport we need must be as swift as the squadrons whose operations they must accompany.

If I am not mistaken this is, indeed, a vast scheme; let us defer, if you will, its realisation, but let us not for that entirely lose sight of it. The day will come when a more fortunate generation will, perhaps, deem it too modest. The eclipse which we are undergoing, will be more or less long; but France is destined to emerge from the shadow, and our descendants will have difficulty in comprehending our present discouragement.

In the midst of the bitterness with which our hearts are overflowing, I fix my eyes on a future, which we of an older generation shall not see, but you, for whom Heaven in its mysterious dispensations is preparing it, take care that it does not come upon you unawares. Do not imitate the foolish virgins of Holy Writ, whose lamps were without oil when the bridegroom came. Watch! for who can tell the moment when it will be said, "The hour is come"? Watch! and most carefully preserve our great institutions. The Navy of To-morrow will then have no cause to envy the Navy of To-day.

Captain GOODENOUGH: I think you will feel no inclination at this late hour to commence any discussion on this paper. I merely ask you to return your thanks to Admiral Ryder for his kindness in taking so much pains in bringing it before us; we know he never spares any pains for our good. I would merely say that Admiral Jurien is known not only as a consummate writer on naval affairs, but as an elegant French writer—that he is known as such even amongst academicians. I therefore think that younger members of our profession cannot do better than read his works as a study of French, as well as a study of the particular subject of which they treat.

LECTURE.

Friday, February 28th, 1873.

Lieut.-General Sir FREDERICK CHAPMAN, K.C.B., Director-General of Fortifications, in the Chair.

MANTEUFFEL'S CAMPAIGN IN THE EAST OF FRANCE.

By Captain H. A. Gun, R.E.

The section of the Franco-Prussian War of 1870–71, about which I have put together these notes, is that which had for its scene the country about the Côte d'Or and Jura Mountains in the south-east of France, and is known indifferently as the operations of the Army of the East, to French, and of the Army of the South, to German, writers. The central operation round which the campaign hangs, is the Siege of Belfort. It was to relieve that fortress, that Bourbaki led his army from Bourges to Montbeliard, and fought a three-days' battle there; and it was in the first instance to protect the besieging army, that General Manteuffel carried the IId and VIIth German Army Corps across the Côte d'Or and Plateau of Langres. It was in this campaign that Garibaldi took a part,—a part unfortunately hardly worthy of the hero of Italian independence. Finally, this campaign was the last act of the Great War, lasting after the curtain had fallen over the rest of France.

In order to avoid overcrowding of names on the map, some of the places alluded to in the text have not been placed on it. Their situations can be easily identified by referring to the following table:—

- Baigneux les Juifs, Chanceaux, — between Montbard and Lamargelle.
- Marac, N.W. of Langres.
- Bligny, Verey, — near St. Seine.
- Echenans, north of Hericourt.
- Byans, Champey, Busserei, — villages in front of Hericourt, on right bank of the Lisaine.

St. Marie, Aibre, Tavey, } villages in front of Hericourt, on right bank of the Lisaine.
Bethoncourt, between Hericourt and Montbeliard.
Mignavilliers, Faymont, } near Athesans.
Arcey, near Montbeliard.
Thil Chatel, close to Is-sur-Tille.
Dain, Plombières, } villages about Talaut.
Fontaine, close to Talaut.
Abeny, Messigny, Darois, Ruffey, } villages north of Dijon, on the road to Langres.
Ornans, south of Montbeliard.
St. Fergueux, four miles east of Villersexel.
Etuz, on the Soane, near Pin.
Rioz, near Montbozon.
Censeau, north of Nozeroy.
Forests of Chailloz and Chatillon, on the right bank of the Doubs, above Besançon.
Verne, near Rioz.
La Barre, close to Dampierre, on the Doubs.
Deservilliers, south of Amancey.
St. Laurent, south of Les Planches.
Chaffois, Sombacourt, } road Levier-Pontarlier.
Varois, Mont Seine, Rolland, Bourg } between Dijon and Auxonne.
Sancey, west of Hyppolite.
Frasne, near Pontarlier.

It is not easy to assign an exact date for the commencement of a set of operations; and the 18th of December, 1870, has been chosen in this lecture, because it is a convenient time at which to consider the relative positions of parties, not because it was absolutely the commencement of the campaign.

The country in which the operations took place lies in the Departments of Côte d'Or, Jura, Doubs, and Haut-Rhin, in the old provinces of Burgundy and Franche Comté.

The principal natural features are the Côte d'Or Mountains, the Plateau of Langres a continuation of the same group on the west, and the Jura Mountains on the east. These ranges, especially the Jura, are of considerable height and importance; they are much covered with woods, and except by the roads which traverse them, are impassable for troops. The columns marching on these roads can have little communication with each other, as there are few cross-roads, and such

as there are, are indeed only poor ruts or paths. The country between the ranges, though never flat, is comparatively so, and is well cultivated and rich, with numerous towns, villages, and free passage in most directions. Here also are numerous woods, however, and it may be termed a close country for military movements.

The large river Saone receives all the water of the district, and traverses it from north-east to south-west. It varies considerably in width and depth; but, in general, a full pontoon train is needed for passing it. Its principal tributary is the Doubs, which flows first north-east, forming the boundary between France and Switzerland, then turning round the north of the Jura, flows south-west to join the Saone at Verdun. It is a swift, deep stream, 40 to 100 yards wide, and is therefore a considerable obstacle. The Doubs at its head receives the Lisaine, a small stream running between steep hills, affording admirable defensive positions; the Savoureuse, which flows by Belfort, and other waters. The Burgundy Canal comes from the north-west to Dijon, and thence to St. Jean de Losne, where it joins the Saone. It is of importance as a means of transport along the south of the theatre of the campaign, but there are many locks on its course, which retard the navigation. The River Ognon is a considerable stream, which cannot be passed by troops. It joins the Saone at Pontarlier. The Tille, also of some magnitude, flows along the foot of the Cote d'Or to join the Saone, south of Auxonne. The Suzon joins the Ouche at Dijon, and this river then flows to the Saone parallel to the Burgundy Canal.

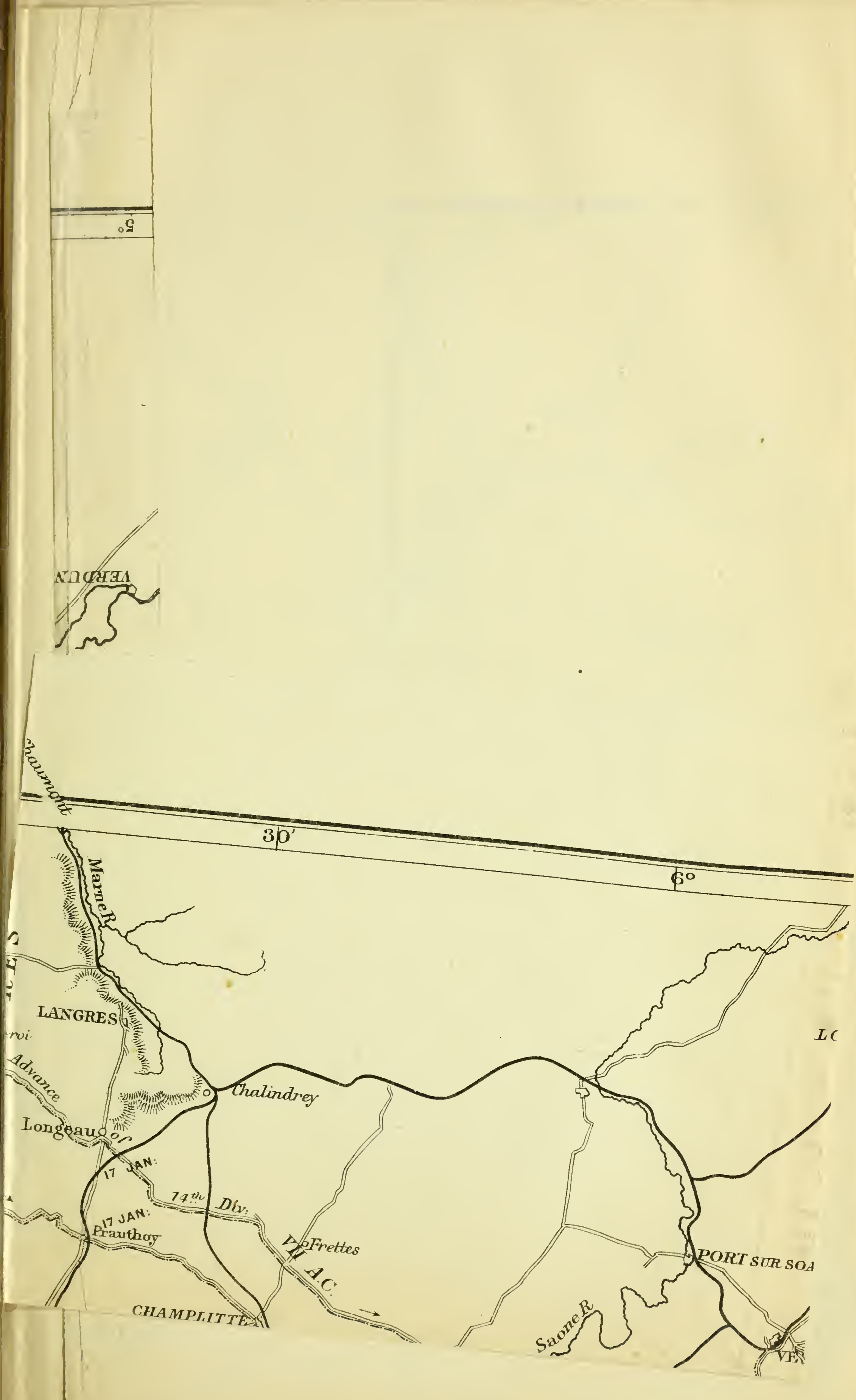
Finally, on the western side of the Cote d'Or, rise several rivers, the Amançon, which the Burgundy Canal follows to the north-west, the Aube, Seine, and Marne, all here small streams. There are, of course, numerous small waters feeding the above-mentioned rivers, but such as could be crossed by a trestle-bridge equipment in the absence of bridges or pontoons.

There are four fortresses, three of the first-class, in the district; these are, Belfort, situated in the well-known gap between the Vosges and Jura Mountains,—a gap, however, full of hills, some of considerable size. Belfort has a powerful enciente, and has also detached works, some of long standing, others constructed just before and during the war. Besançon, in a loop of the Doubs, a very strong place, with detached works, rather too close to the fortress for modern warfare, but nevertheless sheltering it against an attack. This town could protect 10,000 or 15,000 men within its enciente, and a large army in its immediate neighbourhood. Langres, on the northern spur of the plateau, had received a great deal of attention from the French engineers before the war, and with its four detached works, could only be taken by regular siege. Auxonne, the fourth of the fortresses, is a small bastioned work of no great importance, but on the Dijon-Dole railway, at an important point.

Dijon, not now a fortified town, is of importance from its position in the Cote d'Or, from its size, 30,000 inhabitants, and from its being the railway junction from Paris to Lyons and Switzerland. The other towns that may be noted are, Dole on the Doubs, with 9,000 inhabitants; Gray on the Saone; and Vesoul with 7,000. At these there


MAP
to illustrate
CAPTAIN GUN'S LECTURE
ON
MANTEUFFELS CAMPAIGN
IN THE EAST OF FRANCE.
English Statute Miles
TONNERRE
CHABLIS
NOYERS
MONTBARD
AVALLON
SEMUR
VITTEAUX
AUTUN
CHATILLON
MUSSY
LANGRES
CHAMPLITTE
DIJON
NUITS
BEAUNE
SEURRE
VERDUN
CHALON
AUXONNE
DOLE
GRAY
BESANCON
VESOUL
LURE
BELFORT
GIROMAGNY
VILLERSEXEL
MONTBELLIARD
DELLE
BAUME
ORNANS
QUINGEY
SALINS
ARBOIS
POLIGNY
LONS-LE-SAUNIER
PONTARLIER
MORTEAU
NEUCHATEL
L. DE NEUCHATEL
PLATEAU OF LANGRES
COTE D'OR
JURA MOUNTAINS
FORET DE CHAUX
Saone R.
Doubs R.
Ognon R.
Tille R.
Ouche R.
Canal de Bourgogne
II A.C.
VII A.C.
XIV
To Chaumont
To Epinal
To Lyons

J. Jobbins



Chaumont
30'
6°
Marne R.
LANGRES
Advance
Chalindrey
Longeau
17 JAN:
14th Div:
17 JAN:
Prauthoy
Frettes
VII A.C.
CHAMPLITTE
PORT SUR SOA
Saone R.

are also railway junctions. Chaumont, Chatillon, and Tonnerre are towns on the north-western side of the district, and Montbeliard and Pontarlier lie in the Jura, the latter town being nearly on the Swiss frontier. The railways are, the great Paris-Basle line, on the north, passing by and closed by the positions of Langres and Belfort; the Paris-Neufchatel railroad passing by Tonnerre, Dijon, Auxonne, Pontarlier; the railway to Lyons from Dijon, diverging to Bourges at Chagny, a place to be noted on that account: and the cross lines of Nuits-Chatillon-Chaumont, Auxonne-Vesoul, Gray-Langres, Dole-Belfort. These last are all single lines.

The line from Vesoul north by Epinul leads to Nancy and Metz, and is very important in a military sense, as was illustrated in these operations.

There are numerous good roads connecting all the towns; the national and departmental roads are all of the first-class, the communal roads, some good and some bad, but in great part admitting the passage of artillery. I will only allude especially to one of these roads, that right through the Jura by Salins and Pontarlier and La Cluse on the extreme frontier, and for the reason that at Salins and La Cluse are hill forts, which, if occupied by artillery, completely close the passage, and this circumstance had considerable effect at the end of the operations.

Before indicating the positions of the armies on the 18th December, I will, in a very few words, sketch the operations preceding which led to them. After the fall of Strasbourg, on the 27th September, 1870, General von Werder, with the XIVth Army Corps and detachments, in all 55,000 strong, with 150 guns, was detached to the four Departments I have named above. His orders were to lay siege to the places near the Rhine, and to Belfort, and generally to oppose the formation of new corps of the enemy, and to crush "insurrections," as they were rather unreasonably termed, amongst the inhabitants. The siege of Belfort was commenced by the 1st Reserve Division, General Treskow, 17,000 men, on the 4th November, whilst von Werder pushed on and occupied Dijon, Gray, Vesoul, &c. Besançon, Auxonne, and Langres remained in the possession of the French; at a later date, General von Goltz, of Werder's Army, began the siege of the latter, but was repelled before he had received heavy guns, or made any impression. General Debschitz, also of this Corps, was occupied with the fortresses on the Rhine until the end of December.

On the 4th December, the final rout of D'Aurelle de Paladin's army took place at Orleans, and the French Government immediately proposed a new set of plans for the further prosecution of the war. These consisted in the formation of an army under Chanzy, whose mission was to draw on himself the forces of Prince Frederick Charles, whilst a new army, to be called "of the East," was assigned to General Bourbaki, and was to co-operate with Garibaldi, who, with 10,000 men, which were being rapidly added to, was at Autun, south of Dijon; conjointly they were to raise the siege of Belfort, push von Werder northwards, and so come down on, and cut the communications with Strasbourg and Metz, or carry the war into Germany,—a bold and

ambitious scheme certainly, but one which necessitated great promptitude and much organization.

Accordingly, the XVth, XVIIIth, and XXth French Corps were withdrawn from General Chanzy, and a new corps—the XXIVth—was formed at Lyons, and assigned to General de Bressoles, who had risen rapidly in rank during the war. Under him General Cremer had a division: he was a young and energetic, but rough and somewhat boisterous, Officer, who had escaped from captivity in Germany under circumstances which the Germans at the time considered equivalent to a breach of patrol. General Bourbaki had commanded the Imperial Guard at the commencement of the war, and had a considerable reputation, but apparently, as an Imperialist, he was under some suspicion, and a M. de Serres was attached to him as a sort of public safety man, or commissioner, an arrangement which probably hampered the General a good deal.

About the 18th December the arrangements for this Army of the East were completed, and the concentration of the troops—120,000 strong, with 300 guns—had taken place. General Cremer had already moved to Autun. These operations were closely watched by the Versailles authorities, and the VIIth German A. Corps, less one division, was moved from the country about Troyes, where it had lain on the communications with the east to Chatillon, to be in observation. Prince Frederick Charles also had a division at Vierzon, near Bourges, and abstained for the present from following Chanzy to the west.

We have then on the date mentioned,—in Belfort, 17,000 men of mixed, regular troops, and mobiles, under an energetic commandant, Colonel Denfert Rochereau, an Engineer Officer, resisting General Treskow's attack with about the same number; in Langres, a French garrison of 10,000 or 15,000 badly-organised mobiles, under Colonel Mazière, an Engineer Officer also, watched by General von Goltz, with 6,000 men; in Besançon, 15,000 men; in Auxonne, a small garrison of mobiles; at Autun, Garibaldi, with 13,000 men, badly trained, and so indifferently equipped, that a few days later he could not move his troops because they wanted great coats. It will be recollected that it was mid-winter, and exceptionally cold. At Nuits, south of Dijon, Cremer, with 15,000 or 20,000, being the advance of the army of Bourbaki; that General, with 100,000 or so, was at Bourges, assembling the XXth Corps; the XVth Corps was about Vierzon, watching Prince Frederick Charles. The XXIVth Corps, less Cremer's division, was at Lyons.

On the German side, the Baden Division of the XIVth Corps, General von Glümer's, was in Dijon; the 4th Reserve Division, General Schmeling, was principally in Gray and Vesoul; and, as we have seen, General von Goltz, with a special detachment, observed Langres, and General Treskow, with the 1st Reserve Division, and some small detachments, besieged Belfort, where the second parallel against the forts on the Paris road was just being constructed; General Debschitz, with 6,000 or 7,000, was in East Elsass.

The VIIth corps, General von Zastrow, had one division on the scene of action about Montbard, Chatillon, and Chaumont.

We learn that another plan of action to that decided upon, viz., the relief of Belfort by the whole Army, had been proposed to the French Government at Bordeaux, of whom M. Gambetta was the ruling spirit, and M. de Freycinet the acting War Minister. This plan would have directed Bourbaki's army by Nevers, La Charité, and Montargis, on to Fontainbleau, whilst Garibaldi, assisted by the newly formed XXIVth corps, pressed on Werder and relieved Belfort. This was abandoned, as it would have involved again meeting Prince Frederick Charles to the east of Orleans, and no success could have been hoped for against his army. The plan already alluded to was then decided upon in greater detail. Bourbaki was to march on Dijon with XVIIIth and XXth corps, de Bressoles on Besançon, there to rally to him the garrison. It was calculated that at Dijon there would then be 70,000 (with Garibaldi) against 40,000 Germans; that the latter would be overwhelmed, and that a joint advance on Belfort would be made from Dijon and from Besançon. The case which actually occurred of von Werder not waiting to be thus beaten in detail did not apparently present itself. The XVth corps was to remain at Vierzon for the present.

The object of the French Army was the relief of the siege of Belfort and their chief starting point, Bourges, distant 220 miles. At Lyons were great stores, and one of the army corps, and the first base of the French may be said to be the line Bourges-Lyons; the railroads from these two points in the direction of Belfort, pass between the Côte d'Or and Jura Mountains, and Dijon and Mouchard, places at the feet of these ranges respectively, are connected by rail. These may be considered, therefore, as the extremes of the second base of the French Army. On this base, was a small fortress, Auxonne, in their possession, and somewhat in front another, Besançon, of the first rank. The western end, however Dijon, was at the begining of operations in the enemy's hands, and its possession was of the first importance. From this base, the movement up the valleys of the Saone and Doubs must be made, and it was therefore essential that it should be kept in French hands in order that supplies might be received during an advance, or that the means of retreat by rail should be secured.

As a safeguard during either of these operations, the lines of the Saone and Côte d'Or must be held against an enemy advancing from the west.

The base of the German Army entering the theatre from the west, would be the line Chaumont—Nuits connected with each other by rail, and each communicating with Paris. The second natural base in an advance on the Saone, is the line Langres—Dijon connected by the road running at the eastern fort of the Cote d'Or range. The extremes of this base were in the actual circumstances held by the French, and, therefore, a third more advanced base became necessary on the Saone itself between Gray and Vesnel, unless Langres and Dijon were first occupied by the Germans. This base on the Saone could not be supplied by the lines of railway from Chaumont and Nuits, since these pass by Langres and Dijon, but by its own prolongation to the north to Epinal, a town in German hands; that place omes, therefore, the

real base of the Army when arrived on the line of the Saone, or if from this line it should swing round on Besançon and Dole.

On the 18th December fighting began. General von Glümr in command at Dijon, had moved out on the 16th with his two brigades of infantry, a division of cavalry and artillery in two columns, and on the 18th attacked Cremer at Nuits on the Dijon-Beaune-road. Ricciotti Garibaldi came from Autun with a brigade to assist General Cremer. The French were beaten and retreated to Chagny, but the Badeners returned next day to Dijon without holding so advanced a position. It does not appear why Garibaldi remained at Autun (23 miles distant, but connected by rail) during this period. There was indeed then and afterwards a deplorable want of unison between him and the other commanders.

On the 23rd, General de Bressoles came to Nuits and assumed command of Cremer's troops. I may here state that owing to disagreements between de Bressoles and Cremer, the latter was henceforth given separate command of his division of about 15,000 men, and worked independently in future.

On the 25th, the XVIIIth corps arrived at Chagny from Bourges. On the 27th the Baden Division was withdrawn by von Werder from Dijon, and retired on Gray; General Cremer with Garibaldi's chief of the staff entered Dijon the same day, de Bressoles returned to Besançon and began to operate with the XXIVth corps in the Jura towards Montbeliard. General Garibaldi remains at Autun; he was very ill at the time, and, probably on this account, unable to display his old energy. On the German side it was still uncertain whether these movements were intended for an effort against Chaumont and Troges by Langres, or against Belfort; the VIIth corps, therefore, retains its position of observation about Chaumont.

General von Debschitz arrives at Delle near Belfort, from East Elsass, having reduced the Rhine fortresses.

On the 31st, the XVth French corps leaves Vierzon, Prince Frederick Charles having decided to follow Chanzy to the west. Bourbaki's army was therefore now complete.

On the 2nd January, 1871, Colonel Bordonne, chief of General Garibaldi's staff, receives particulars about the VIIth German Army Corps; it is estimated by his informants to be 16,000 or 17,000 strong; he also hears of the march of large numbers of Germans from Montargis, by Sens, Jugny, Tonnere, and from Villeneuve and Troyes, to a point of concentration between Chatillon and Chaumont. These were in fact the IInd Army Corps troops now ordered down from the siege of Paris, and the other division, the 14th, of the VIIth German Corps. It is hardly necessary to state that the divisions of the German Army are numbered consecutively, two belonging to each corps, so that the 3rd and 4th divisions belonged to the IInd Army Corps; the 13th and 14th to the VIIth Army Corps. The XIVth Army Corps was, however, made up of divisions not so numbered. This day, too, the 2nd, De Bressoles got to some outpost fighting with Treskow's troops at places near Delle, and their presence was duly reported to Versailles; still, however, the staff there did not feel sure about the objects of the new army, of the concentration of which they had good information.

It is possible that a bold movement of Ricciotti Garibaldi undertaken at this time, tended to keep them in doubt. That brigade commander was detached from Dijon with 2,400 men about the 2nd; he threw some outposts out of Senur to the west, and on the 8th had an engagement with detachments of the VIIth Army Corps near Montbard. He was defeated, losing half his force, but made good his retreat to Is-sur-Tille, fighting his way through Baigneux les Juifs, and established himself between Dijon and Langres on one of the Côte d'Or passes on the 14th inst. This, however, is in anticipation.

On the 1st the bulk of the French were in the towns on the railway between Auxonne and Clerval; the XVIIIth corps principally about the former place; the XXth corps about Dampierre; the XVth at Clerval: this last corps had been sent on from Basançon by General Bourbaki, and appear to have suffered great hardships from the want of preparation for disembarking or feeding them at Clerval. General Cremer remains at Dijon for the present.

General Bourbaki had his head-quarters in Besançon. Two courses of action were there discussed by the French Staff. The first of these would have sent two corps, the XXth and XXIVth, from Besançon up the Doubs, marching on either side of that river to Clerval; thence by the great road to Blamont, and crossing the Doubs at Audincourt, they were to debouch east of Montbeliard. The XVIIIth corps would proceed from Auxonne or Besançon by Rougemont on Villersexel, and then to Chagey (8 miles west of Belfort). The XVth corps would have formed the general reserve, and would march from Clerval to the west of Montbeliard. The Cremer Division would move on Langres, take up the garrison there, and form a mobile corps to protect the passes of the Côte d'Or and the left of Bourbaki's army in conjunction with Garibaldi at Dijon. It was argued that the position of the Germans in front of Belfort would then be taken in front and in reverse, whilst the Doubs and the Bergundy canal would with the railway serve to victual the army. In case of reverse the same good roads as they advanced by would be open for retreat as well as also those, equally good, traversing the length of the Jura range. It will be seen, however, I think, that, as the case stood, Von Werder, with his 40,000 troops, would have overwhelmed the XVIIIth corps, and Cremer's at Villersexel, and then have moved to the east against the XVth, XXth, XXIVth, whilst, if Treskow could not have held his own against these latter in front of Belfort, he would have easily joined Werder who would have been then united on the French left.

The second plan simply consisted in massing on Villersexel and Vesoul, where Werder was expected to be found, and fighting him there (should he wait).

Cremer alone was to move as soon as possible round by Gray on to the German flank.

No provision was to be made to guard the Coté d'Or passes beyond what Garibaldi could do, and moreover it was left an open matter between Bourbaki and Garibaldi, which should be responsible for the passages of the Saone and Doubs.

On the 2nd January the XVIIIth Corps moved from Auxonne, and crossed the Ognon at Pesmes; the bridge there had been blown up by the Germans in retreating, and the infantry crossed on the ice, the artillery and cavalry on a bridge of boats.

The XXth Corps moved up to Voray from Dampierre, sur Doubs, and crossed the Ognon there, and both marched on Villersexel.

The XXIVth Corps assembled in Besançon; its outposts had been all over the Jura; it followed the other corps to Villersexel.

The XVth Corps also moved in the same direction from Clerval and Beaume les Dames.

Cremer remained at Dijon for the present, the line of rail not being clear for his movement to Vesoul.

On the 5th, Girabaldi moves from Autun, reaching Dijon on the 7th, and henceforth we are to consider him posted there, and held responsible for the protection of that important place by the War Administration at Bordeaux. He had no cavalry or field artillery worth mentioning, but many guns to mount for the defence of the town, and this he did, strengthening it especially on the side of the Montbard road, where the ground favoured him.

9th January. General von Werder had determined on a retreat to a battle position, the length of the Lisaine, and had some of his troops there at this time; he determined, however, to check the heads of the French columns before taking up his defensive attitude; he had already had reconnaissances made of them as they advanced, and there had been some outpost fighting. This morning he advanced early from Vesoul with the 4th Reserve Division (Schmeling) and von Goltz's detachment, which had been withdrawn from Langres, probably 10,000 or 12,000 men, and appeared before the Chateau of Villersexel, a magnificent pile, the property of the Marquis de Grammont, just before the French advance came up to it. All that day a serious fight took place about the chateau, which with the town remained in the German hands at night-fall; next morning these left it before daybreak, and fell back on the Hericourt position, where active preparations were made for a stubborn defence. The siege of Belfort was continued unintermittingly, but siege guns were withdrawn to put on the heights overlooking the Lisaine.

The 10th. General Bourbaki rested to obtain provisions; the 11th, 12th, 13th, he distributed his troops between Villersexel, l'Isle-sur-Doubs, and Lure; and only on the 15th was ready to move from those places for the attack of von Werder on his chosen position. Cremer moved on the 9th from Dijon, and on the 19th reached Lure. The Germans in retreating had not destroyed railway or bridges; they expected assistance from the west, and left the passages open. On the other hand, and for the same reason, Cremer ordered the destruction of bridges behind him, but these instructions were entrusted to civil engineers and local persons, who dreaded German reprisals on them, if they as civilians took part in the war, and the orders were neglected. Bourbaki was 120,000 strong, but his troops were deficient in provisions and clothes.

We have particular accounts of the wretched plight of Cremer's

corps on entering Lure on the 14th. General Cremer indeed ordered double rations of everything, including brandy for men and *horses;* it is pathetically added by an eye-witness that the intention was good, but, as there was nothing to be had, could not be carried out. Here we must leave them for the present, only noting the length of time it had taken to bring the Army from Bourges, whence it started on the 20th December to Hericourt, where it arrived on the 14th January. The story of the delays, as told by M. de Freycinet and others, is a sad tale of want of organisation and direction over the lines of railway, as well as of miscalculation of their powers of transport on single lines.

By the 11th January the reports from Von Werder relative to the fight at Villersexel on the 9th, where portions of all four French corps were engaged, had fully established the object and extent of the French advance, and, as at the same time all difficulties in the west were over by the successful battles at Le Mans on the 10th, the Versailles Staff determined on the formation of an army to be called "of the South," to be placed under the orders of General Manteuffel, who had handed over the command in the north to General von Göeben.

That day, the 11th, General Manteuffel had an interview with the Emperor William, and quitted Versailles next morning for Chatillon, there to commence his operations.

There was much in favour of an advance on Dijon; the railways to Montbard were in German hands; Garibaldi could be easily overwhelmed; and the railroads when repaired, would afford a secure base for operating between the Saone and the Doubs, whilst the connection of the French with Bourges would be severed.

Time would, however, be lost in making this circuit from Chatillon to Belfort, and it appeared to General Manteuffel that it was incumbent on him to take the shortest route, so as to press at once on the forces attacking von Werder. This would be by the roads to Vesoul. Should General von Werder have to retreat, Manteuffel could follow the French and redeem the situation; should he hold his ground, Bourbaki would be placed between the two armies; in the case of his being victorious and of the French retreating (as happened), then, by swinging round to the right from Gray, the Army of the South would cut off the enemy from Lyons, and force them to fight in the Jura, capitulate, or cross the frontier. In order, however, to move on Vesoul with his full force, it would be necessary for the German Commander to leave Langres and Dijon behind him, slightly watched, and to submit to the loss of his communications with Chatillon, the roads from which run between those places. Therefore he prepared a new base at Epinal; thither was sent the train of the 14th Division, which had not yet joined it, from the north, where the VIIth corps had been engaged, and there was established, under the direction of the Governor-General of Loraine and the Etappen Commanders, the provisions and stores which would be required on reaching Vesoul or Gray.

On the forenoon of the 13th, all these decisions were arrived at at the headquarters at Chatillon, and the position of General Manteuffel's corps on that date was as follows:—

IInd Army Corps at Nuits sur Ravières and Noyers nearly complete

about 27,000 strong, with 84 field guns and but few cavalry. General Fransecky commanded the corps.

VIIth Army Corps had one division about Mussy and Chatillon and one at Montigny; this latter, the 14th, without its train and wanting several battalions; the corps was less than 20,000 strong; General Von Zastrow in command.

General Kettler, with a brigade of infantry, two battalions, and two squadrons, was to "contain" Garibaldi, and was left about Montbard. The 1st Reserve Regiment of Hussars, previously left at the disposal of the Etappen Inspector-General at Nuits, was also available for General Kettler.

The French had parties of troops between Langres and Dijon: at Langres, 10,000 or 15,000 Mobiles; at Dijon, as we have seen, Garibaldi's force was 15,000 strong.

General Von Werder was in telegraphic communication with Versailles, as also was Manteuffel, and so they communicated with each other; but the wire from Paris only extended to Chatillon, and the messages were for the next fortnight sent on to Manteuffel's headquarters by post relays, which worked in an admirable way, notwithstanding the bad weather and the scouting parties of French about. Neither IInd or IIIrd Army Corps had a field telegraph equipment.

General Manteuffel, as we have seen, aimed at Vesoul; he had to traverse the Côte d'Or mountains and debouch on the great Dijon-Langres road in the first place, and he formed three columns for that purpose. He foresaw that these columns, in traversing the wooded mountains, would see little or nothing of each other, and in the "instructions" issued from Chatillon, the Commanders were directed to march through as quickly as possible to their respective points of sortie, viz., Is sur Tille, Prauthoy, Longeau. Arrived there, they could extend parties along the great road and feel and wait for each other. The "instructions" concluded with a noteworthy sentence: "I hereby ratify in advance all measures for which my sanction is necessary, so that the hands of the commanding Generals may not be tied by any regulations."

14th. The IInd Army Corps marched in the direction of Montbard, Chanceaux, Selongey.

The VIIth Army Corps right column: Chatillon, Recey, Prauthoy; and left column Montigny, Arc en Barois, Chameroy. The day was intensely cold, the roads very good but were covered with ice, and it was only by the greatest exertions that the guns could be got along. The advanced guards marched well ahead, and encountered Ricotti Garibaldi's force, which was dispersed.

16th. A division of the 7th Corps reached Longeau, and sent outposts towards Langres; these were shelled from the forts.

17th. The remaining division of the VIIth Corps, after four days' march, reached Longeau, and sent advanced guards on to Champlitte, Fontaine Francaise, and Mirebeau, turning a few troops out of these places. Railway and telegraph at Chalindrey were cut by them. I should mention that a skirmish had taken place at Marac on the left of the VIIth Corps' march during the passage of the mountains, where

troops from Langres had been posted. This excepted, the garrison had made no opposition to the movement.

IInd Army Corps had a division, the 3rd, this morning at Is sur Tille, from whence Menotti Garibaldi with a brigade retired without fighting, though they slightly molested the outposts on the right.

The 4th division of this corps was still in the mountains echeloned back to Lamargelle. It had been delayed by combats at Bligny and Verey, with 3,000 Garibaldians from Dijon.

Whilst the IInd and VIIth Corps were thus successfully threading the passes of the Côte d'Or, General Von Werder was engaged in a three days' battle before Belfort, and this, the turning event of the campaign and a conspicuous scene of the war, must now be described.

The excellence of the positions on the banks of the Lisaine has been already noticed.

The line taken up was extensive for 35,000 men, about the number Von Werder had to dispose of without calling on Von Treskow's besieging division for assistance. On the right, about Chenebier, stood the Baden Division, Von Glümer; the right centre was held by General von Goltz, who stood at Echenans in force, and occupied Byans and Champey in front. The centre and left centre was watched by the 4th Reserve Division, General Schneling, who had troops in Hericourt, Bussurei, Bethoncourt, and Montbeliard, the outpost in the villages of Ste. Marie, Aibre, and Tavey. These outposts were driven in by the advance of the French. Montbeliard is a point of the greatest importance. It is alike on a junction of railways and roads leading through the gap of Belfort. Its occupation by the enemy would turn the whole line and throw the army off its line of retreat into Elsass. It was therefore fortified with care. The castle rises above the town, which forms a very strong post, and here and on the hills around were planted many guns. Thirty-seven of the siege guns, including 16 24-pounders, were in position here and at different parts of the line, 12 at the castle 25 at adjacent points.

The extreme left was held by General Debschitz. Finally, a grand reserve was formed between Hericourt and Brevilliers, at which latter place were General von Werder's headquarters..

The French arrangements for the attack of this line were thus made: On the 15th, XXth and XXIVth Corps were to march from Arcey to Hericourt, spread out there, and attack whatever was before them. They marched on the high road between L'Isle and Hericourt. XVth Corps to march from L'Isle to Montbeliard, and attack that town. One regiment, the 24th, was detached to the right of the town to turn the position, and there of course met General Debschitz' force. The XVIIIth corps was ordered to march from Villersexel on Chagey by Athesans, Miguavilliers, Faymont, Beyerne; finally, the Cremer division was to march on the departmental road from Lure to Hericourt, as far as Beyerne, there to turn off to the left and attack the enemy's right about Chenebier. These last two movements were most unfortunately directed. From Villersexel to Chagey there are no good roads, and the XVIIIth Corps struggled all day along the "sentiers" which were covered with ice and snow. Cremer's division had a good

march to Beyerne, but thereabouts were cut in two by the XVIIIth corps marching at right angles to them, and then having to quit the main road and take to the abominable "sentiers," did not get to any work before Chenebier until 3 P.M. Part of their route, which had been specially indicated by a Staff Officer of Bourbaki's, lay across a frozen pond, and a spectator congratulates himself that the German batteries did not fire a few round shot which would have left them floundering in the ice. It seems difficult to explain why the XVIIIth Corps did not march from Lure to Hericourt, and the corps of Cremer from Lure by Rouchamp to Frahier, where both would have good roads and avoided collision. We see throughout, the want of a good staff, and of organization on the part of General Bourbaki; the roads appeared to be quite unknown to him.

On the 15th, the French pushed on with much vigour about Hericourt and Montbeliard, occupied all the villages on the right of the Lisaine, and the town of Montbeliard itself, but failed to take the castle or to cross the stream, on the left of which the strong position of the Germans lay.

The night was fearfully cold; the French troops, half-clothed and less than half-fed, lay huddled round bivouac fires, without distinction of ranks. It may be mentioned, as an instance of their want of provisions, that a horse struck by a shell during the day's fight was forthwith cut up into steaks, and cooked on the spot.

16th.—Cremer's division now fully up on the right, carried Chenebier, and penetrated to Frahier, the troops of von Goltz then falling back to Chalonvillars. No impression was, however, made on the rest of the line.

17th.—Generals Degenfeld and Keller marched before daybreak, and after some fighting, retook Chenebier, and forced back the French left. The fighting on the rest of the line was continued, but with less spirit by the French, who were not in trim for such a long-continued combat.

In the evening, therefore, General Bourbaki found that he could hope for no success against such strong and well-held positions, and ordered a general retreat.

The nature of the country precluded the use of the German cavalry, of which we hear nothing during this battle. It was despatched either during the action, or immediately after, round by the Lure road to open communications with Manteuffel's advance.

The losses were considerable, but not excessive, on both sides. The Germans lost about 1,700 killed and wounded, the French about double that number. The numbers engaged have been already stated, viz., about 120,000 French and 35,000 Germans.

It is curious to turn to the garrison of Belfort, and see what impression was made upon them by the battle so long continued a few miles only outside their forts. They appear to have had little or no information of the strength or position of the approaching army; they heard the cannon at Villersexel (21 miles) on the 9th, and then on the 15th along the Frahier-Montbeliard line. They also were aware, by the slackening of the siege fire, that guns had been withdrawn from the

batteries, and the Commandant eagerly hoped for the opportunity which might rise if the investing army was weakened. He made eight reconnaissances of a few hundred men or so, on the 15th, 16th, 17th, five towards the north with the view of proving the strength of the enemy; one of these had fighting on the Paris road, but all were driven back by the German outposts, which were not weakened. No sortie on a large scale was made. At this period of the siege, the Germans were strongly entrenched in their lines round Belfort, and the distance at which these were now drawn round fortresses with detached forts is to be noted as a difficulty in making effective sorties.

General Manteuffel was at Prauthoy whilst his columns were marching through the Cote d'Or, and it was there that he received each day by telegraph and post from Chatillon the account of the previous day's fighting round Belfort; on the 17th, we have seen his columns in great part disengaged from the mountains, but he was not then certain whether Bourbaki would be beaten off; he therefore decided to press on towards Vesoul especially with the VIIth, his left corps, bearing in mind that should the march to the right, already thought of in case of Bourbaki's retreat, take place, this flank of the army would have to march farther than the other to perform the outer sweep of the circle.

18th.—The VIIth corps marches from Prauthoy and Longeau to Champlitte and Frettes, still in two columns.

The IInd corps from Thilchatel towards Fontaine Française, a short distance only, waiting for its tail yet in the mountains. An advanced guard was sent on to Gray to destroy the railway which was the means of communication of the French with Dijon, and to made good the bridges over the Saone. News now came to Prauthoy of the Belfort victory, and retreat of the Eastern army, and Manteuffel at once decided on his preconceived flank march; the essence of which would be the rapid seizure of the railways from Besançon to Dole and Mouchard. When this idea was communicated to General von Moltke at Versailles, he is said to have observed to the Emperor that it was a manœuvre of great boldness, and that blame should not attach to the Commander of the Southern Army in case of failure, as such important enterprises involved corresponding risks.

19th.—Detachments pushed by VIIth corps towards Vesoul and to Lure secure those places, and look out for Willisen, known to be detained by von Werder with 1,200 cavalry in that direction. The bulk of the corps reaches Dampierre on the Soane, and Vaite.

The IInd Army Corps collects about Fontaine Française, a brigade, the 7th, well to the right, to watch Garibaldi, who, however, makes no sign.

Von Werder, having rested on the 18th, follows, this day, Bourbaki, who was in retreat towards Besançon.

It seems surprising that Garibaldi and Mazière at Dijon and Langres did so little in these days to harass their enemy. We have heard of Menotti and Riciotti Garibaldi with small parties in the Cote d'Or, but of the masses, nothing. General Bordonne (he became General about this time), Garibaldi's Chief of the Staff, declares that they were left

without any information, either from Bourbaki or Bourdeaux, and that being without cavalry he could make no reconnaisances. He believed, moreover, that the whole of the IInd corps remained at Montbard ready to move down on him if he quitted Dijon. We have, however, seen that General Kettler with a small force was really there alone.

General Manteuffel rightly judged that by this time, however, the 19th, the real state of things would be known at Dijon unless some means were taken to further deceive the Staff there, and mask the German advance. Accordingly he ordered, and it was faithfully executed, one of the most conspicuous and boldest enterprises of this war. It was entrusted to General Kettler.

We have seen him left at Montbard on the 13th. His force was 5½ battalions infantry, 2 squadrons, and about 2 batteries artillery. On the 10th he had been to Avallon, to punish that town for firing on a patrol, and had returned to Montbard the 17th. He was now ordered to move on Dijon, and attack that place with his little force. I propose to follow his movements during the next three days in the execution of this successful little feat of war.

Dijon is now an open town, the ancient ramparts being laid out as gardens. It lies at the foot of the Cote d'Or, which close in round it on the north and west, and partially on the east; the south is an open country, studded with vineyards. The Bourgoyne Canal, Avallon Road, and Paris Railway enter by a valley on the west, and the road to St. Seine and Montbard to the north of these. This latter passes in a defile between two hills, Talant and Fontaine les Dijon, very suitable for defence. Further out from the town is another defile at St. Suzon.

Garibaldi had artillery at Talant and Fontaine, and had fortified these posts. His total strength in guns was 60, viz., 20 12-pounders, 40 of smaller size, and as well as 20 mountain pieces. He had, I believe, 30,000 men in about the town.

On the 20th Kettler reached Sombernon, on the southern, and St. Seine, on the northern road from Montbard to Dijon, in two columns.

The 21st, his left column, forced the St. Suzon pass after some opposition, and reached Daix at 1.30 P.M. He then attacked the troops there, not in great number, and occupied them until the arrival of his right column (which had crossed the railway and river) at Plombières.

The whole force then advanced and drove the enemy back to the Talant and Fontaine hills, upon which no impression was made; after a loss of 14 officers and 320 men, Kettler withdrew to Abeny. Here he was joined by Major Couta, with the Fusilier battalion of the 61st regiment (Pomeranian), who had been left at Is sur Tille by the 2nd corps to keep up communications and escort a train. Major Couta had to attack a strong force of enemy at Messigny (said to be 6,000 strong) on his way to join Kettler; he drove these back, however.

22nd. Leaving his patrols in observation, Kettler withdrew to Darois out of sight of the French, who were in a great state of excitement in the town, believing that the whole of a German corps was on them.

23rd. He attacked again on both sides of the Langres road,

marching by Ruffey, and penetrated almost to the town; but the artillery fire was too strong for his progress, and at dark, after losing many men, he retired up the Langres road.

It was in this day's action that, as is well known, the battalion of the 61st lost the only colour taken during the whole of the war by the French, who found it next morning under the bodies of the standard-bearer and lieutenant. The Emperor William, I may add, ordered a new set of colours to be presented to the battalion, in August of the same year, with every mark of honour.

After this sanguinary fight General Kettler remained in observation about the town, changing his detachments very often, and keeping the enemy in check; and so successful had been his operations that the Garibaldians asserted that 70,000 Germans had attacked them, coming from west, north, east, and probably believe so to this day.

We may now turn back to the main advance of General Manteuffel's corps, and watch the measures taken to intercept the French Army retreating from Montbeliard. The ultimate fate of that Army is well known, and appears, indeed, inevitable, seeing that they had failed before the single corps of von Werder, and two fresh corps were now arriving, but it is interesting to trace the steps which led to the final consummation.

19th. General Manteuffel's chief desire now was to learn if the French were making entirely for Besançon, or in part for Vesoul and Langres. It turned out that a certain number had taken the latter route, but von Werder's reports seemed to give assurance that it was only the case in a small degree, and that he (Werder) would move round to Rougemont, so as to prevent any further movement.

20th. VIIth corps crosses the Saone at Savigneux and Autet, and moves on to the line Savigny-Citey, the advanced Guards towards Besançon. Patrols to the left in Vesoul.

IInd army corps about Gray, the heads of the columns ten miles in advance, and advanced Guards on to Pesmes; the bridge over the Ognon there had been destroyed by the XIVth corps, and had to be repaired. In the meantime a pontoon bridge was thrown. (It will be remembered that the 18th French corps crossed here on the 1st January.) The 7th brigade, which had been left about Mirebeau to observe Garibaldi, finding everything quiet (it was the day before Kettler's attack), marched on to Essertene and crossed the Saone there; a battalion was left at Mirebeau and remained there during the rest of the operations. The XIVth corps moves into Onans, St. Fergeux, and Athesans.

The trains of the IInd and VIIth corps were this day brought to the right bank of the Saone, and it will be seen that General Manteuffel had now fairly severed himself from his communications with Chatillon. Owing to the inactivity of the Langres garrison (we have seen what means were adopted for keeping back the Dijon people) posts did pass between Chatillon and the head-quarters of the Army without intermission, but the service of provisions would necessarily be stopped. Manteuffel was now on his new line of communication with Epinal, but it was not yet open to him, the enemy being in Vesoul and elsewhere

along the line. It will be remembered that the 14th division was yet without its train, which was still detained at Epinal. Colonel Willisen, who had two regiments of cavalry and a battery of horse artillery, and who would clear the country from Loup to Vesoul, was therefore anxiously expected on the left. The Southern Army was indeed, as we have seen, weak in cavalry. This day Willisen reached Lure.

The 21st. Colonel Willisin reaches Noroy-le-Bourg to the right of the XIVth corps; VIIth corps is at Marnay, Pin, Etuz, on the Ognon. These three places were held by troops from Besançon, who before retreating partially blew the bridges, and detained the heads of the German columns in consequence. Patrols moving to the left, heard of Cremer's corps about Rioz and Montbozon, just in the line of von Werder's advance.

2nd Army Corps reaches Pesmes. Its advanced guard seizes Dôle (14 miles ahead), and there surprises some troops of the enemy, and storms the town; the bridge had not been destroyed by the French. No less than 230 cars of provisions moving up from Bourges by Dijon were captured, a most important circumstance in the then state of the two armies—both in want of stores.

Von Werder is in Villersexel and neighbourhood.

Colonel Willisen at Noroi-le-Bourg, near Vesoul.

The retreat of the French was now fully directed on Besançon, from whence they could reach Lyons, their only point of safety.

22nd was a day of comparative rest. The VIIth corps reached Dampierre on Doubs, stationing part of a division on the Marnay-Besançon road, to cover the movement to Dampierre from the garrison at Besançon. The bridges over the Doubs found uninjured, which saved time, as the pontoon train of the corps was at Epinal, and only that of the IInd corps available to cross the river here, 300 feet wide. The IInd corps also crossed at Dampierre, and pushed on to save the passages of the Clone, Loue, and Orain, small tributaries of the Doubs. These were uninjured and undefended, though obstacles were found constructed. The main body marched to Dôle.

Bulk of the French about Besançon, but de Bressoles corps still near Blamont in the north of the Jura, watched there by General Debschitz.

23rd. By the evening the corps were thus situated. Werder at Montbozon, Rougemont, L'Ile-sur-Doubs, Clerval, having turned the enemy out of these places. VIIth corps astride of the Doubs at Dampierre and Quingey, facing Besançon; its outposts near that town were attacked in the evening by some of Bourbaki's troops, whom they thus for the first time encountered.

2nd corps remains in Dôle, where General Manteuffel has his headquarters. Advanced guards on to Vaudray; a brigade under Colonel Knesebech covers the communications back to Gray.

Willisen is in Vesoul, which he cleared of troops, and thus obtained the line of railway. It had, however, been broken, and was not yet available for transport.

We are arrived at an interesting moment of the campaign. General Manteuffel was at the foot of the Jura. He held the Besançon-Dijon

and Besançon-Lyons railway, and it now behoved him to consider his prospects of enclosing thoroughly the enemy before him. We have fortunately one of those valuable but rare aids to military history, the views of the responsible commander at the moment of a crisis, not written as so many have been, after the event. I allude to Manteuffel's General Instructions, written on the evening of the 23rd at Dôle, and sent out to Corps Commanders early next morning.

He considers that there were at that time six courses that were possible for the French Commander to pursue:—

(1.) That he might essay the road leading southwards by Ornans, Levier, Censeau. Then the IInd and VIIth corps, who have troops well across the Doubs, must throw themselves in his way.

(2.) He may attempt to force through by Dampierre and Quingey. He will then meet divisions of the IInd and VIIth Corps, who must arrest him, whilst von Werder moved down on his rear.

(3.) He may attempt to reach Gray by Marnay. The division of the VIIth corps and Knesebech on the right bank must hold him, whilst Werder again presses down on him.

(4.) Should he turn up the Doubs or to the XIVth corps, the IInd and VIIth would follow him northwards.

(5.) *Should he take the Ornans, Pontarlier Road, the advanced guards of all three corps must pursue him.*

(6.) In the event of his waiting under the guns of Besançon, he could be reduced by famine.

Having thus indicated the probable nature of the operations, General Manteuffel concluded his instructons with the usual proviso, that commanders were to initiate operations in accordance with their spirit, without waiting for his precise orders, in case circumstances should demand a sudden resolution.

Cases (1) and (5), viz., marches by roads east of Quingey did in fact occur, and we shall see how they were met presently.

It will be seen that all the hypothetical cases, except the (3rd), that which would have taken the French towards Dijon by Gray, demanded von Werder's movement towards Besançon, *i.e.*, down close to the Doubs. It was this case that that commander had however considered probable, and on the 24th, before receiving his chief's orders, he had moved to the westwards towards Rioz, only leaving Schmeling's division on the left bank of the Doubs between Clerval, Beaume les Dames, and St. Juan d'Adam. It is to be noted that von Werder was aware of great difficulties which would be met in marching through the forests of Chailluz and Chatillon, on the route Manteuffel suggested. Schmeling He had about 10 battalions, 8 squadrons, 6 batteries. I call attention to his position and to that of Debschitz with 7 battalions, 2 squadrons, 2 batteries at Blamont, east of Montbeliard, as a few days later, the absence of these divisions in the north of the Jura was like, but for other reasons, to have influenced the end of the campaign. General Debschitz, I may here state, had on the 23rd found about 6,000 of

Bressole's corps still in front of him, had attacked them, and captured 400 prisoners.

IInd Army Corps reaches Vaudrey, pushing patrols to secure Mouchard, the railway junction, where a slight combat took place.

VIIth Army Corps sends detachments to Myon, Chatillon and Port Lesny on the Loue, meeting the enemy in small forces. Patrols also communicated at Mouchard with the IInd corps. Von Werder, von Schmeling to Rioz and Verne.

25th. General Manteuffel having now heard of von Werder's march westwards, could no longer bring that General's corps down on Besançon, and it being useless and impolitic to interfere with his movements, desired him now to continue on the right bank, but to close in to Marnay, and free the VIIth corps from their duties there. The French were on both banks of the Doubs about Besançon, and needed watching.

IInd Army Corps stretched eastwards, occupying Mouchard and Villers Farley in force; patrols on to Salins, Arbois, Poligny, meeting enemy before the first of these places.

Willisen now in Dôle, having marched from Vesoul by Pesmes, is given Knesebech's brigade in addition to his own cavalry, and directed to destroy railway between Dijon and Dôle.

The line Gray to Vesoul was now in order, and relays worked on it, which was the more necessary, as the Langres garrison had began to show activity, and to molest the lines through the Cote d'Or.

The XXth corps, French, commences the retreat along the Ornans road.

26th. IInd Army Corps. The Salins Pass, which I have referred to, as being defended by two forts, was attempted by a brigade of this corps, but found to be too strong. Reconnaissance parties were sent round it, however. by mountain paths. 7th brigade of this corps at Arbois, 6th at Mouchard. VIIth corps about Quingey, patrols on to clear the banks of the Loue. XIVth corps to Marnay.

On the French side part of the 15th corps leaves Besançon for Ornans, and the right bank of the Doubs is completely evacuated by them.

It was this evening that General Bourbaki committed suicide; we have yet to learn the secret history of that ill-fated commander's relations with the Government and with his army during this campaign, and at present it is hopeless to attempt to form an estimate of them. Suffice it to say, that when on the 25th the Bordeaux Ministry received a cypher despatch from him, written the day before, and announcing that his last chance was gone, and that he had only to retreat to Pontarlier, and cross the Swiss frontier or surrender, they decided to supersede him and nominate General Clinchant, the commander of the XXth corps, to the chief command. The dispatch answering this crossed that conveying the news of the suicidal attempt, and was received at Besançon the 27th. These despatches must have passed through the German outposts.

27th. The events of this day are highly interesting. First of all, the XIVth corps, coming into position between Marnay and Besançon,

relieves the 14th division of the VIIth corps in sentry duty over the fortress, and this last division crosses the river at once. The entire VIIth corps is now about Quingey, with patrols out along the Loue; that river was undefended.

IInd Army Corps. General Fransecky had left 4 battalions of a brigade near Salins, and the other two brigades were between Mouchard and Arbois. His patrols out towards Censeau, Champagnole now told him of the assembly there of French troops. This appeared to indicate clearly that contingency No. 1, the march, viz., by Levier, Champagnole had begun, and General Fransecky set all his troops in motion to Arbois and on to Censeau; the troops west of Salins (the 4 battalions) were relieved by VIIth corps men, and then followed their own division. It will be seen that it was necessary to guard against any enemy issuing from Salins on to the Quingey-Arbois road.

The enemy thus signalled at Censeau and Champagnole, were indeed a mixed force of those French corps, which had the first start out of Besançon, and who to the number of 15,000 did get clear to Lons-le-Saulnier. But for the Salins forts and their resistance the previous day, the IInd corps would have been on the Levier, Censeau road, and probably intercepted these parties. As it was, the wider sweep round by Arbois saved them.

This day also, General Manteuffel having all his three corps well in hand, determines to rid himself of the Garibaldians at Dijon, who though for the moment restrained by Kettler, might come down at any time on his present rear at Dole. Indeed they were, as we shall see, on the eve of attempting this.

A division is therefore formed under General Hann von Weyghern, the Commander of the 4th division. It consisted of the Kettler division, already near Dijon, the Willisen brigade lately spoken of, a brigade and battery of the 14th corps, and the solitary battalion left at Mirebeau, in all 11½ battalions, 2 regiments and 3 squadrons cavalry, and 5 batteries of artillery. The orders given were, that this division should attack Dijon, or act on the communications of the French there, and relieve the army in the Jura of all anxiety from that side. I shall allude to their operations, which resulted in the capture of Dijon presently.

This day the telegraphic communication was opened by Epinal and Vesoul to La Barre, near Dampierre, on the Doubs, relieving the post service from Chatillon.

The Bordeaux Government had not been idle spectators of the struggle going on in the eastern Departments; they had made considerable efforts towards provisioning Bourbaki's army—we have seen some of their trains, one of 230 cars, fall into German hands—and to raising the numbers of Garibaldi's forces. No less than 50,000 men were on that General's pay sheets at this time, though nothing like that number were present with the colours. For several days M. de Freycinet, at Bordeaux, had believed that only one full German corps had marched on Besançon, and that Bourbaki could break through this number of troops. But now, on the 27th, there was no longer any doubt as to the real situation, and in a note sent to General Clinchant

that evening, he was informed very accurately of the position of the German Corps. He was enjoined to make a last effort to break through and reach Lons-le-Saulnier. At the same time Garibaldi was called upon to move out from Dijon and march to Dôle and up the Doubs, so as to occupy the German corps. Furthermore, 8,000 to 10,000 men were sent up from Lyons to Lons-le-Saulnier, by rail, to co-operate with the Garibaldians.

28th. IInd Army Corps. 5th brigade to Poligny, its advanced guard towards Lons-le-Saulnier comes upon and is stopped by the advance of French troops (those dispatched from Lyons). 6th brigade to Pont de Navry (near Champagnole). 7th brigade to Champagnole, and patrols on to Nozeroy, who captured 50 waggons and many prisoners there. French also reported in some numbers at Les Planches; and in the middle of night (10 P.M.) General Fransecky, at Poligny, turned the 5th brigade and corps artillery out, and started with them for Champagnole, intending to push on Les Planches. General Manteuffel had, however, more correct information about the real numbers of the French that could be at that place, and in the night during the march Fransecky was directed by him on Pontarlier.

VIIth corps, now relieved of duty about Besançon, moved forward to Amacey, Deservilliers with the 14th division, and to Levier with the 13th.

29th. IInd Army Corps on to Censeau, dispersed some Mobiles about Nozeroy, and went into cantonments about those places. A patrol went to Les Planches, turned some dragoons out of that place, who had been sent *forward* from St. Laurent, being part of the Lyons division.

VIIth Army Corps. 14th division marches on Levier by the cross road, Amacey-Levier; a guard on to Chaffois, who had there a two hours' fight before gaining the village; a detachment to Sombacourt, who also had to fight for the village, which is on the main road the French had used and were using for their retreat. No less than 4,000 men were made prisoners this day. The outposts of the 13th division, wishing to cross the Loue about Ornans and feel for Schmeling, could not do so, as there were many French there, and the division followed the 13th division to Levier.

General Hann von Weyghern had decided on moving on Dijon by Pesmes and Gray, in order to join General Kettler, who was at Messigny, on the Dijon-Langres road, at this time. It appears that it had been contemplated to march by St. Jean de Losne and Nuits, to the south of the Dôle-Dijon Railway, but that it had appeared probable that the bridges over the Saone would be destroyed, and, moreover, though Dijon would be reached on its least defensible side, the south-east, yet it would be on the side remotest from Kettler's forces. As it was, General Hann was at Esserterne and Mirebeau on the evening of the 29th.

At the same time Garibaldi had moved with two brigades out from Dijon, on the Auxonne, Dôle Road, and on the evening of the 29th had his outposts on the line Varois, Auxonne, Mont Senne, Rolland. He himself was at Bourg. The rest of his troops were in Dijon and surrounding country, and in the Cote d'Or.

I have now accounted for the positions of all the troops engaged on both sides, except the 4th reserve division, General Schmeling, the detachment of General Debschitz, and the 6,000 men of De Bressole's corps, of whom we heard last on the 22nd, near Blamont. Manteuffel's last plan was that these German troops should come down on the Ornans road, and he had expected them at Etalans on the 28th. Had they been there then and been next day on the road Ornans-Pontarlier, numbers of the French must have laid down their arms.

At that time, however, General Schmeling was far off; in fact, on the 27th he had received the most pressing information from Debschitz of large numbers of French in front of him; this was incorrect; but he hastened off to St. Hypolite, von Werder leaving him general instructions to act for the best. Arrived there, and meeting Debschitz, it was found that the enemy were only De Bressole's men struggling down through the Jura, and Manteuffel now sending express orders to him to come at once to Pontarlier, he started down the Jura in forced marches, having, however, lost what might have been all-important time.

I must now allude to the effect of the Paris fall and capitulation, and the consequent armistice on the war in the east. It is a point on the importance of which on the operations in the Jura, German and French writers thoroughly disagree, and in which I am disposed to agree with the latter to a great extent.

To the comprehension of the question, I have marked on the map the positions of the armies on the evening of the 29th.

French Side.

Columns between Besançon, Ornans, Pontarlier, the bulk in Pontarlier.

15,000 men on the road Les Planches, St. Laurent, or farther south still, being a mixed body of the XXth corps, XXIVth corps, and Cremer's division, with that General in person.

The Lyons division about the same places.

Stragglers in the Jura coming down to Morteau.

Garibaldi with part of his force on roads to Auxonne and St. Jean de Losne, the remainder in and about Dijon.

The garrisons in Belfort, Langres, Auxonne, Besançon, intact.

German Side.

IInd Army Corps in Censeau, Nozeroi, detachments in Les Planches.

VIIth Army Corps about Levier, detachments in Chaffois and Sombacourt.

XIVth Army Corps about Besançon.

General Hann von Weyhern in Mirebeau.

General Schmeling about Sancey.

General Treskow besieging Belfort.

General Debschitz about St. Hypolite.

One road only, Pontarlier-Mouthe, was yet quite open to the French, and this road was within easy reach of Les Planches, and only 10

miles from the IInd corps at Censeau. Nevertheless it seems possible with fighting and marching, holding Pontarlier with a rear guard against the VIIth corps, and with the aid of the men already about St. Laurent, that a great number of the French would have got clear next day.

Next day, however, by an extraordinary mistake, the movements of the French troops were suspended. The reason was this:—

The armistice was signed at Paris on the 28th. Without entering upon its general terms, I will only summarise the last article.

The Departments of Cote d'Or, Doubs, and Jura are for the present excluded from it (the armistice); siege of Belfort (Haut Rhin) to proceed also.

General Manteuffel was informed so by telegraph on the 29th, at 5 P.M.

The Bordeaux Government was also informed by their colleagues in Paris of the armistice, *but not until five days later*, extraordinary as it may appear, of the last article, and then from a German source. Therefore on the 29th both Generals Clinchant and Garibaldi were only informed from Bordeaux of the armistice in general terms, and ordered to suspend all operations.

30th. This day, therefore, we have the spectacle of the Armies acting under different instructions.

General Clinchant sent repeated messages to Manteuffel to claim the benefit of the truce; that General and his subordinates refused all these, and continued operations without a moment's delay.

Therefore the IInd Army Corps attacks Frasue, and captures it and 1,500 prisoners. Manteuffel moves in person from Arbois to near Levier by a cross road to the north of the Salins Pass, which was still occupied the French. Same day the Besançon garrison claim a suspension of hostilities from von Werder, and Garibaldi from Hann von Weghern; both were refused.

31st. VIIth Corps occupied the Ornans-Pontarlier road, up to the Drujeon rivulet, near Pontarlier.

IInd Corps closed in on Pontarlier, about Dampierre; a detachment of $2\frac{1}{2}$ battalions, and 1 battery more on to the Pontarlier-Mouthe road; the enemy found in some force, about St. Marie and La Plencie, on that road, and forced back; 1,500 prisoners were taken, and the passage closed.

Continued demands were received from Clinchant for an armistice, and refused.

On this day General Clinchant issues his last order on French territory to his troops. He announced the error of the Bordeaux Government, by which he had lost the previous day, for retreat, and also his intention of seeking shelter in Switzerland.

1st February. Next morning, at 5 A.M., the convention to that effect was signed with General Herzeg, the Commander of the Swiss Federal Forces, and the operation of crossing the frontier immediately began.

I need only allude slightly to the remaining operations. The VIIth and IInd Army Corps were all up early in the morning and occupied Pontarlier. General Schmeling also arrived, *viâ* Doubs.

The French held a rear guard position at St. Cluse, near the frontier, where is a deep gorge closed by two hill forts, and a considerable fight took place with them, the forts being only occupied by the Germans late in the day. This was the last event of this campaign.

Garibaldi had returned to Dijon from Auxonne, and commenced the movement of his men to Lyons, and this day, the 1st February, General von Werder occupied Dijon at 8 A.M., after but little fighting; five weeks after von Werder's Baden division had quitted it.

The general result attained was that 2 eagles, 12 cannon, 7 mitrailluses, 15,000 prisoners remained in Manteuffel's hands; 80,000 or 85,000 men were driven near the Swiss frontier, and only about 15,000 of the Army of the East effected their retreat to Lyons.

It was not therefore without reason that General Manteuffel in his order of the day of the 2nd February could say that "the marches and "combats amidst the snow and ice of the High Jura had not been "fruitless," whilst his subsequent letter and actions showed how fully he had appreciated the brave resistance made by the French troops; in this all will be disposed to join, and will show in the regret that so much valour should have had to struggle against so many defeats in organization and management.

Belfort capitulated on the 15th February, the garrison marching out with all the honours of war and with their archives.

And now having concluded this imperfect sketch of a small section of the great war of 1870–71, I would venture to make two or three deductions that suggest themselves from this set of operations:—

(1.) Here, as at Paris and Metz, a fortress with detached forts is laid siege to, and the curious, and to the engineer, somewhat anomalous result is seen of a garrison of equal strength to that of the besieging army being unable to break the investment or prevent the advance of his siege works. It will be urged that the troops inside were, at Belfort, of very different calibre to those outside, and this can readily be admitted; but there was a resolute and skilful commandant, several excellent officers, and a sprinkling of good troops in the garrison, and yet they could only occupy an equal number of besiegers. It appears from these three experiences that, although the besiegers are kept at a great distance by detached forts, on the other hand it is very difficult to make sorties unless roads have been specially laid out for the purpose. The extent of country to be traversed is great, and the enemy is not, as formerly, seated on a level glacis, but entrenched in villages and amidst broken country, where his real strength is concealed, and the march out to which takes a long time and precludes surprise.

(2.) On its becoming a necessity for the Badeners at Dijon to retreat before the Army advancing from Bourges, a bold *offensive* is assumed, and the heads of the enemy's columns are vigorously attacked at Nuits, on the 18th December, though the country taken is not held. This action gave time for an orderly evacuation of Dijon.

(3.) The same description of an offensive and defensive operation is repeated at Villersexel on the 9th January. Von Werder might have withdrawn at once to his position on the Lisané; he prefers to await his enemy about Vesoul and to attack him from a flank, again checking the column and compelling a greater concentration, besides the loss of two days at least, days of paramount importance. In both these cases the Germans *advance* to their battle-fields, thus securing the prestige of the attack.

(4.) Of a similar character is the very bold attack by General Kettler on Dijon, 21st to 23rd January. He was fully aware of the great odds against him. 30,000 men and 60 pieces of artillery at least against his 5,000 men. Under such circumstances he could hardly hope for a positive success. It was rather what chess players call a "gambit," the loss of a piece to strengthen the other moves.

(5.) The battle of Belfort or Hericourt was one of the few defensive actions fought by the Germans during the war, and showed that they fully understood that portion of tactics. It was converted into an offensive fight on the third day, and was very promptly followed up.

(6.) The slowness of movement of the French must be noted. They took three weeks to arrive at Villersexel from Bourges, having command of railways up to Clerval. We must do credit to the energy shown in collecting them at Bourges so soon after the disasters at Orleans, and in the efforts made to feed them subsequently.

With a good organisation the French might have been at Villersexel on the 1st instead of the 9th January, and fought the battle of Belfort on the 5th instead of the 15th. It will be remembered that the battle of Bupaume in the North was only fought on the 2nd January, and that a great sortie from Paris was expected about the same time, as also that General Chanzy was not defeated at Le Mans until the 10th January. It seems probable, therefore, that neither General Manteuffel in person or the IInd corps could have been on the scene in the very early days of January; and Bourbaki would have had time to rest before Belfort and renew his attack, or to retreat in an orderly manner on Lyons. The French were greatly in need of cavalry and of a good staff, neither of which can be supplied by ever so great an amount of energy at short notice, and of an effective railway organisation.

(7.) General Manteuffel's operations seem remarkably bold and well thought out. He changed his base in the most perfect manner during the advance, and his information was generally very good. Von Werder and Schmeling's slight departures from his views probably saved bloodshed round Besançon, where another battle and another Sedan might have occurred, had they moved down on it as was intended.

(8.) Garibaldi did not show the energy of former years, or the skill in managing a partisan warfare. He quite failed to carry out

the duty of protecting the flank of the French advance to Belfort, and allowed himself to be easily deceived as to the strength of the force immediately opposed to him. Nothing is more melancholy than to read of the pæans of victory sung by his staff and the Bordeaux Government over the imaginary repulse of 70,000 men before Dijon, and it is with no small surprise that one finds this and other fictions repeated in edition after edition of the semi-official books. General Cremer had strongly wished to take the duty of the guard of the Côte d'Or. Had he done so, and rallied to him the inactive garrison of Langres, there would have been some rough work about Is-sur-Tille and Langres on the 15th, 16th, 17th January, but at the same time Bourbaki would have lost the small gleam of victory vouchsafed to him before Belfort, the capture of Chenebier on the 16th January being due to Cremer's corps.

(9.) After the 17th January Bourbaki could only have saved his army by rapid marching; Dôle lost, and the railway to Lyons lost to him by the 23rd. He had played a gambler's stroke, and left the Saone and Doubs practially undefended. Such marching and such energy was not in the French or their commander at that time. The former unclothed, unfed, and the latter thoroughly dispirited, they could only collect in disorder about Besançon, and it was at the last rather by chance than their own efforts that they were saved capitulating on French territory.

(10.) Lastly, it will be noticed how difficult the advance of the Germans from Dôle through the Jura was; how easily the road was barred as at Salius, on the banks of the Loure, and what confused reports they got of the number of the enemy at points quite close to them, as at Champagnole and at St. Hypolite. The minor operations of this campaign have been but slightly touched upon, and it is to be hoped that some day we shall have fuller accounts of these. It would be of immense interest could we learn from the Germans how they fed their forces, in what degree by requisition, how far by train supplied. Perhaps some one conversant with these details will some day enlighten us on these and other points of which we are at present ignorant. All the details of German organisation are of interest, and none more so than those carried out to the end of the war when Generals, Staff Officers, and men were in full possession of their rare practical experience.

Evening Meeting.

Monday, March 3rd, 1873.

Admiral the Right Honourable the EARL OF LAUDERDALE, K.C.B., in the Chair.

NAMES of MEMBERS who joined the Institution between the 17th February and 3rd March, 1873.

LIFE.

Merceron, Henry, Ens. H.A. Company.

ANNUAL.

Rayner, W. S., Captain 5th Rl. Lanc. Militia.
Newington, C. M. H., Lieut. 22nd Regiment.
Scott, John, Captain 22nd Middx. Rifle Volunteers.
Ashburner, F. J., Lieut. 2nd Dragoon Guards.
Rentzsch, Geo. H., Surgeon 1st Middx. Art. Volunteers.
Holliday, Joseph F., Lieut. 12th Cheshire Rifle Volunteers.
Hunt, J. M. F., Lieut. 1st London Art. Volunteers.
Salmon, Nowell, Captain (V.C.) R.N.
Bower, G. J., Lieut. R.N.
Battye, Montague, Sub-Lieut. 59th Regiment.

LESSONS FROM THE "HOTSPUR-GLATTON" EXPERIMENT.

By Nathaniel Barnaby, Esq., Chief Naval Architect, Admiralty.

The experiment made on the 5th July, 1872, in Portland Harbour, was designed to test the endurance of certain parts of the turret arrangements in the "Glatton," when exposed to fire from a 600-pounder gun at 200 yards, with charges of 85 lbs. of pebble powder.

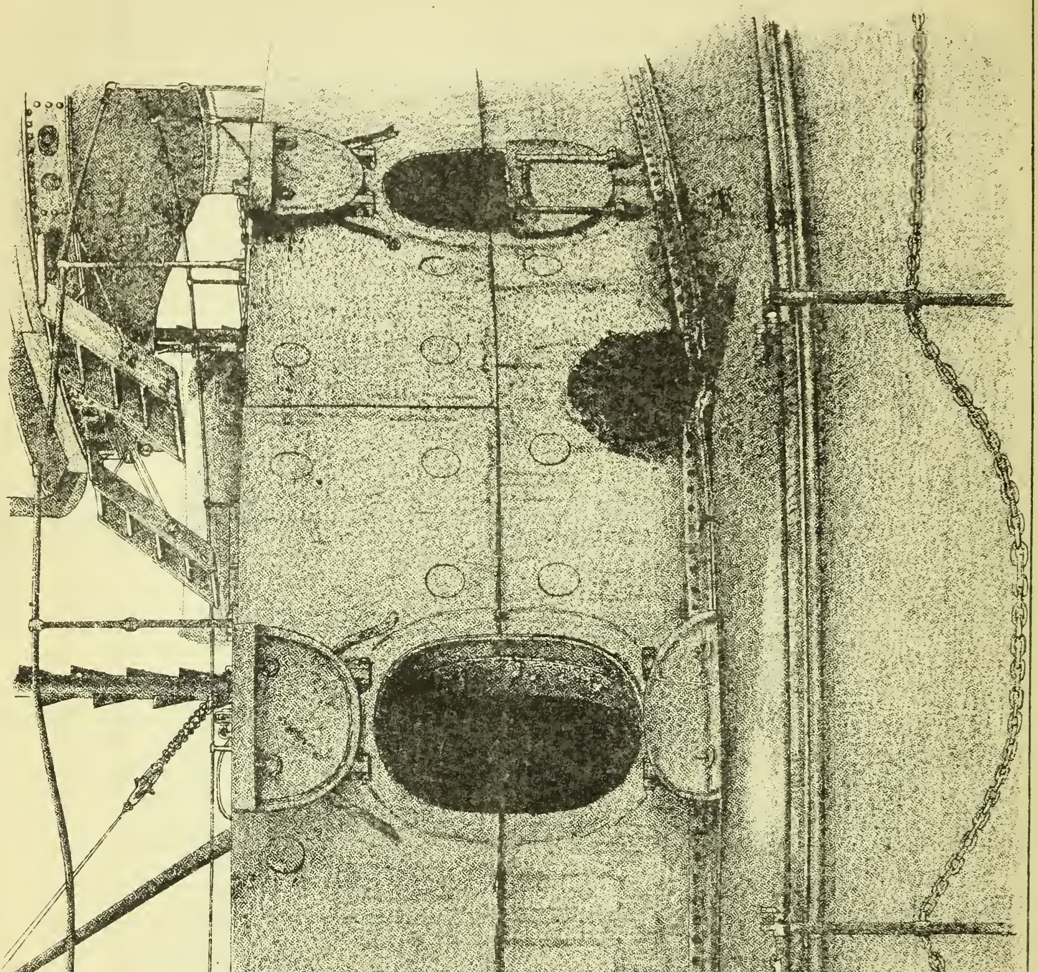
The experiment was not made for the purpose of ascertaining what power of resisting penetration the turret armour possessed, but to set at rest certain questions which had been often raised and which nothing but such a trial could settle.

Of these the most important were:—

1. Was the turret capable of receiving a blow from a heavy projectile at short range, without communicating such a shock to the turning gear as would disable this gear?

2. Would not a shot striking at the junction of the turret and the glacis, lock the turret and prevent it from turning?

THE GLATTON'S TURRET.
From a Photograph taken in the Dock at Chatham.



J. Jobbins

I do not think that mechanicians who had given careful study to the matter before the experiment was made, gained much by the experiment beyond a confirmation of their opinions.

It was proved, as was certainly anticipated by the Constructors of the Navy, that the shock which was communicated to the turning-gear was too small to do it any injury.

With regard to the second question, it showed that a very trying shot did not lock the turret. It did *not* show that no shot would lock it. Those who had but little confidence in turrets, pointed out that, notwithstanding the successful manner in which the turret had withstood the glacis shot, the next shot might lock it, and they would have been entitled to continue to say this after any number of blows had been struck. Those, on the other hand, who considered how much pains had been taken to prevent jamming by a glacis shot, held that it would be impossible to aim a blow more likely to lock the turret than that which had accidentally struck the glacis, and that nothing would be gained by further attempts to hit the junction. Are these then, it will be asked, all the lessons to be learned from the experiment? because in that case, it would appear, that while the outside public were inspired with certain confidence in turrets, which they did not possess before, official people have gained very little. It is at this point, that any interest which my paper may contain will commence. There were other lessons which we needed to be taught, and so far as I have learned them, I will communicate them to you, in compliance with the request of your Council.

We have been told by Captain Dawson, that one lessson to be learned is, that our system of rifling our guns is bad, and that our naval artillery is not what it ought to be. As I am not an artillerist I shall leave that matter in his hands. My business is:—

1stly. To find out just what mischief can be done by the guns, and to guard against and limit it to the fullest possible extent in the structures which have to withstand the fire.

2ndly. To devise the best possible platforms and batteries for the most powerful guns which Woolwich can produce.

You may say to me, that if the Constructors confine their attention to Woolwich productions, they will remain in ignorance of the more terrible powers of foreign guns, and will produce ships with less offensive power than they ought to have, if the proper weapons were supplied. You may even go on to say, that we should insist on having the more powerful foreign guns tried at Shoeburyness. I am contented to note the objection and the recommendation, and to pass on.

The facts are, that a Woolwich gun planted two 600-pound shot in the "Glatton's" turret, and they did the damage to the plates struck, indicated by the diagram (see Plate xiii), and very serious damage it is. I shall not stop to describe it, because it was witnessed by many here, and is well shown by the diagram.

What I am concerned that you should notice, is the almost perfect state of the inner shell or skin of the turret, as ascertained after the armour and wood backing had been stripped off.

This skin and its protective coverings had done their work well, and the energy of the shot was completely absorbed by them without perforation. When it is remembered that the blow was delivered on a space of about three-quarters of a foot, by a pointed projectile weighing 600 pounds, travelling at the rate of about 900 miles an hour, we may well be satisfied with what Chatham and Sheffield together can do in the way of target-making.

But we now come to the imperfections. The fastenings were not all that could be desired. The result of the first blow upon them was as follows:—

A piece of the head of a bolt attaching the armour plate to the backing, $4\frac{1}{2}$ inches in diameter, having been struck by the shot, was broken off 9 inches from the outer end, and thrown out to the front towards the "Hotspur." This piece sunk in deep water. Had this been all, there would have been but little occasion for complaint, but unfortunately, the inner end of this same bolt broke off also, and being projected violently forward, it struck the inner lining of the turret, forced it off from the frames, and passing through the rent, landed on one of the guns. The inner lining had been fastened with small screws tapped into the frames, and of these 52 were broken and were lying about the turret. Three screw-nuts fastening the wood-backing and some tapped screws in the skin-plating were also broken off. After all the damage had been noted, the steam turning gear which had been connected during the trial, and the hand turning gear were both worked and found to be in perfect order. The right gun was then raised and lowered by the hydraulic apparatus, and no damage whatever was visible to the turret or guns.

After the second shot, it was found that other screws in the lining were broken, the heads being projected forwards into the turret.

After this, the turret was again revolved by hand and steam, and the guns within it were loaded and fired out to sea with battering charges and Palliser shot.

Although many tapped screws and rivets were dislodged and broken, they were found chiefly on the floor of the turret close to the injured part, apparently having dropped from their positions. There were no marks or scratches either on the guns or on the paint work of the turret inside, as might have been expected to be the case, had the nuts or rivets flown about with violence. The exception to this was the nut of the armour bolt. Had the guns been manned by their full complement of men, some casualties would probably have occurred, but the Committee considered that there was no reason to believe that such casualties would have been serious.

It is, in fact, not improbable that had the turret been lined with matting within the iron lining, nothing but the nut of the armour bolt would have found its way through.

In view of this breaking of the bolts, it became necessary to consider whether some remedy could not be devised.

I may perhaps be told that if, instead of using elastic cup-washers on the points of the bolts, we had adopted some other form, the points would not have broken.

Horizontal Section of Wall of Turret of Thunderer, Devastation, Fury & Rupert.

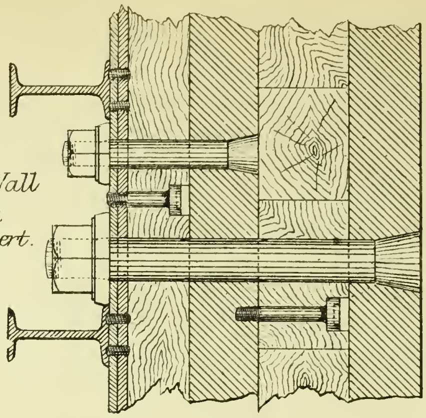


Fig. 2.

Vertical Section of Wall of Turret to be adopted in the Fury.

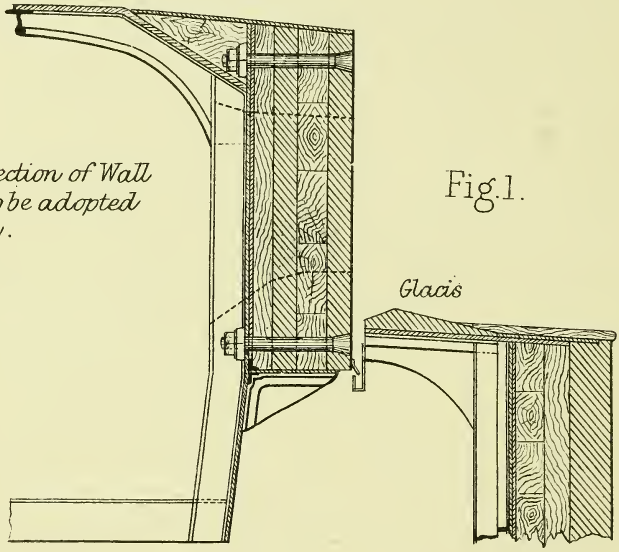


Fig. 1.

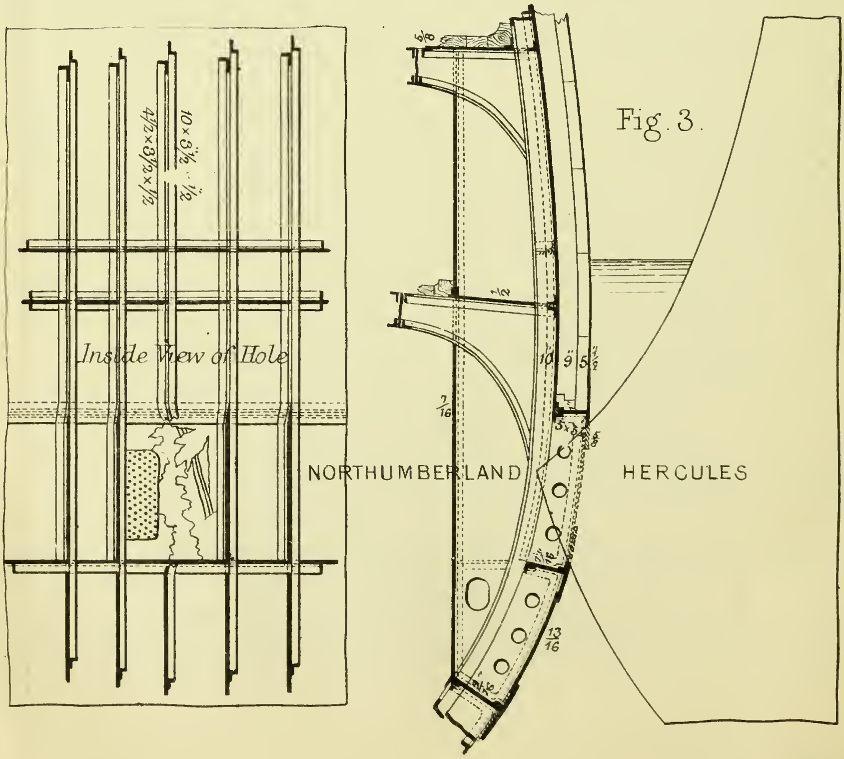


Fig. 3.

I do not propose to discuss this matter, but would merely say that a set of trials are now going on at Chatham, to determine by a percussive test the relative values of different plans suitable for naval purposes. The very excellent plan in use by the War Department is not included among them, because it is not suitable for ships.

Assuming as we do that whatever form of bolt is adopted, such a blow as that received on the "Glatton's" turret, would have broken the inner end of it, we have adopted the device shown in the diagram, (Plate xiv, fig. 1,); by which the risk of having such broken points projected into the turret is greatly reduced. This plan requires us to make the turret-armour in two thicknesses of the full depth of the turret, as in the turrets of the "Thunderer," "Devastation," "Fury," and "Rupert." See diagram (Plate xiv, fig. 2).

To prevent the *heads* or *points* of rivets being knocked off and projected into the turret, continuous screws are used without heads or points. There are other details in which improvements have been made that may have importance in practice, but which do not appear to possess enough to justify me in bringing them to your notice.

You would doubtless prefer that I should say something as to the lessons taught at Portland, affecting the general usefulness of the turret as a part of the machinery of a ship-of-war, and I am willing to do so.

I think it may be said that the popular confidence in the turret has been increased, and I hold that inasmuch as there was a good deal of unfounded prejudice against it which the trial helped to remove, this increase in the popular confidence is just and right. But there was another feature in the experiment which was very suggestive. I witnessed the firing from on board the "Hotspur," and I saw the care with which the ships were moored at 200 yards range, and the pains taken to get the precise amount of elevation supposed to be required (21′). Four sighting shots were fired, and then, although there was no wind, and scarce a ripple on the water—the first shot at the turret itself, hit the sighting bull's eye, placed $28\frac{3}{8}$ inches above the point on the turret which it was intended to strike.

The next shot, fired with 15′ elevation, hit the turret, but at a lower point than was intended, as it struck near the joint of the armour; and it hit also on one side of the centre line between the ports, so that it came upon one of the bolts which it had been intended to avoid.

The next shot was intended to strike the turret about 17 inches above the deck, but instead of doing so, it struck the deck, indented it, cracked the glacis-plate, and then did its best to lock the turret by forcing its way $13\frac{1}{2}$ inches into the armour and stopping there.

This inaccuracy was probably due to a slight motion in the "Hot-" spur," only perceptible upon very close observation.

With this amount of inaccuracy, under circumstances the most favourable that can be conceived, what inaccuracy and chance shooting there must be on the open seas, when the gun and gunner are being rolled through vertical arcs not of minutes but of degrees; when the ship is also lifting and then lowering the gun bodily several times in a minute through feet of vertical space, at one time adding to

the upward motion of the gun produced by rolling and then abating it, so that in allowing for this motion in the shot when it leaves the gun, the gunner must at one moment allow for roll and heave together, and at the next for the difference between the two? I am not able to say—I suppose no one could—how many times in a minute the "Monarch" or "Captain" would have been able to have fired with turret guns in the heat of an action, but a good test of rapid firing at a large mark at about 1,000 yards has been made with the "Monarch" and "Hercules."

In five minutes the "Monarch" fired twelve rounds from her four 12-inch guns—*i.e*, three rounds per gun. The "Hercules" fired seventeen rounds in the same time from her broadside of four 10-inch guns—*i.e.*, $4\frac{1}{4}$ rounds per gun. The proportion of hits to the rounds fired, was also rather more than 6 per cent. in favour of the "Hercules."

Taking the number of rounds per gun at three in five minutes, it is said by many persons that in an action this would be also the number of rounds per turret, as the two guns would nearly always be fired together. If this were so, that would be little more than one discharge per minute from the turrets of a ship like the "Monarch" or "Captain."

Having settled for ourselves what we will estimate the rate of firing to be in a turret in an action and the risk of missing, let us now bring in the further consideration that to protect two 25-ton guns as they are protected in the "Glatton," you must devote the weight of 6 other pairs of 25-ton guns to make the turret, *i.e.*, given 14 25-ton guns, you must take the weight of 12 to cover the other two; or, to put the matter more fairly, given two pairs of 25-ton guns, with carriages, slides, and full chase allowance of shot, shell, powder, and stores, we must take one pair of guns and its ammunition to make a turret for the other pair, so that the luxury of a turret armament, as compared with unprotected guns, obliges us to give up half our guns and ammunition. Observe, I do not compare turret-armour with broadside-armour; I am simply shewing what we have to pay for armoured defence on the turret-system in actual weight of ordnance.

I will ask you now to cross the Channel and see what our quick-witted neighbours are doing; and I must say of the French naval designers, that in my opinion they are second to none in ingenuity, skill, and enterprise in these matters.

Now, how many turrets of the "Royal Sovereign," "Monarch," "Captain," and "Glatton" type has France introduced into her Navy?—Not one.

I ask myself why this is, and I imagine their answers to be:—

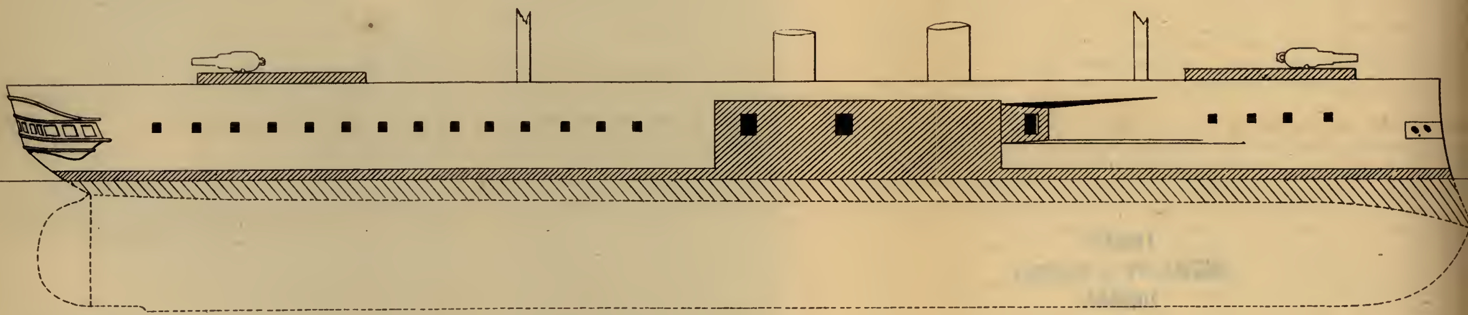
1st. We have no ships in which we should think it wise to dispose a weight equal to that of the guns and their ammunition as a cover for such guns.

2nd. When we desire to fire at an enemy, we like to see him, and we stand a better chance of doing so, when we and our gun are not shut up in a box.

3rd. In a masted ship your turret does not give an all-round fire; you cannot fire either ahead or astern.

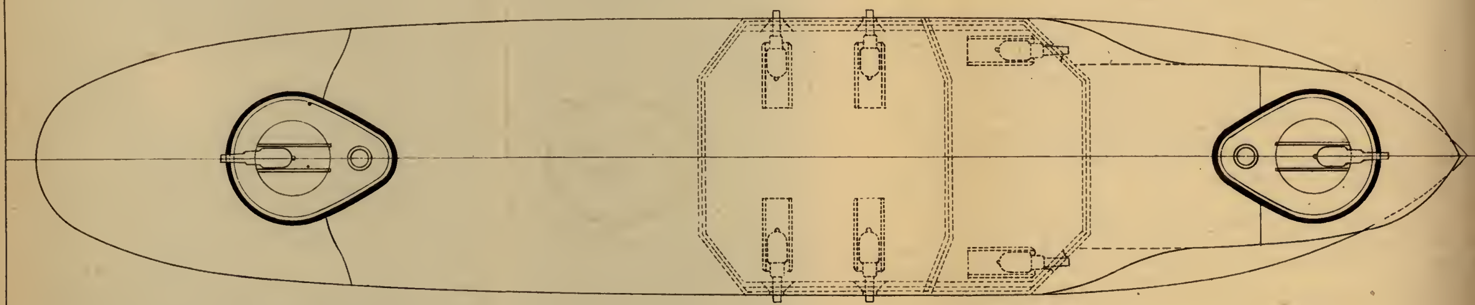
H. M. S. "TÉMÉRAIRE"

WITH ENCLOSED BATTERIES ON THE MAIN DECK AND BARBETTE TOWERS ON THE UPPER DECK



PLAN OF UPPER AND MAIN DECKS.

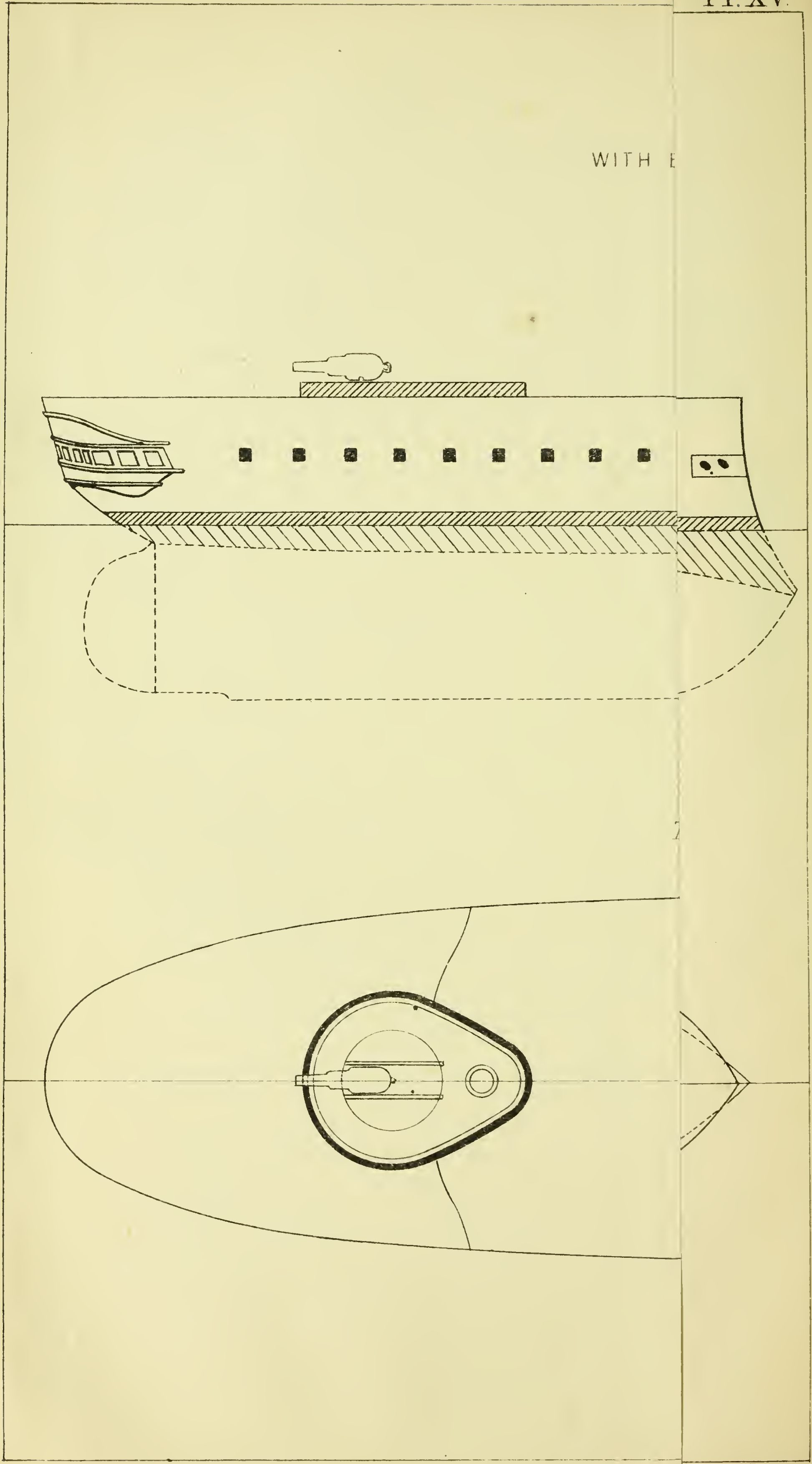
The dotted lines represent the Guns and Bulkheads on the main deck.



N.B. The shaded parts represent armour

J. Jobbins

Pl. XV.



J. Jobbins

We prefer a plan which is about half the weight of yours; in which we can always keep our enemy in sight, and fire when we can make sure of hitting him; in which we are not embarrassed with smoke to the same extent as a turret is, and in which we can fire right ahead and right astern. That plan is the "barbette battery."

I imagine those to be their answers.

We must not however lose sight of the disadvantages of their plan. They are—That the gun is exposed to fire, and may be dismounted or otherwise disabled by a shot or shell which would not enter a turret, and that there must be a certain amount of exposure, on the part of the gun's crew, to fire from musketry and case-shot in a close action. This latter is, however, reduced to a minimum by the adoption of breech-loading guns, so that the loaders are protected by the gun itself.

I have said that this mode of mounting heavy guns involves about half the weight of the ordinary turret. This may be seen from the illustration of it given in the accompanying diagram, in which barbette turrets are placed at the bow and stern of the ship. (*Vide* diagram of Téméraire.)

According to what I assume to be the French view, which I have placed before you for consideration, every masted *turret* ship must necessarily be an extravagant ship, *i. e.*, she must be weak for her size and cost.

Persons who take this view, would admit the success of the "Monarch," for example, but would consider that some £400,000 is too much money to pay for a ship with only two turrets and only 7-inch armour for the protection of her hull.

I give you no opinion of my own on that matter, but I simply throw out these suggestions, which naturally arise from a consideration of the slowness of fire in a ship with turrets, and the general uncertainty of hitting when you do fire in a naval engagement.

In conclusion, I should like to put before you a few questions for your consideration, as to the use and distribution of armour in ships of war.

1st. Is armour retained in ships of war to protect the gunners or to protect the ship?

2nd. If for both purposes, in what proportion should it be distributed? should the armour in front of the guns be one-fourth thicker than that protecting hull, boilers, and magazines, as it was in the "Captain"?

3rd. Or, remembering that men are of no use in an action without a ship to fight in, but that a ship may remain an efficient engine of war with neither guns nor gunners—remembering this—ought we to keep the hull afloat at all hazards to life and limb from shot and shell?

4th. If we stint the armour on the hull in order that we may thicken that upon the battery, will not a wise enemy, if he happens to have guns enough, fire broadsides into the hull-armour in order to endeavour to reach the machinery or magazines, and fire, at the same time, with light guns at the gun-ports.

5th. If you decide that the hull must have the preference, and should have thicker armour and surer defence than the guns and gunners, it may be that you would go so far as to say that, in an extreme case,

where the weights were strictly limited, you would even leave the guns without armour, in order that the hull may be made secure.

6th. The abandonment of armour protection for the guns leads at once to an increase in the power of the artillery, because the increase in the number of guns, presents but little difficulty as to weights, if they do not require to be armoured. Do you then consider that when we have a ship which has been so armoured as to be practically unsinkable by shot; in which the boilers and magazines have been made secure; and in which the number and power of the guns have been so increased, that a concentrated broadside may mean six or seven 18-ton guns—all directed at the same spot, and fired by wire at the same moment—do you consider that such a ship would stand a fair chance in fighting with an enemy with penetrable hull plating and few guns,—but those guns protected by armour?

7th. If you think she would, let me add, an armoured traverse at each end of the gun-deck, with ports in it for right ahead and right astern fire, and let me add also an upper deck armament of light guns to fire at the ports of the enemy, and she will probably commend herself still more to your judgment.

Such a ship as I have sketched, may some day meet with favour from those who have to fight the ships. They must be consulted to the fullest extent; and I do not think that such a ship should be forced upon the Navy as an armoured ship to fight other armoured ships, until the sailors are fully satisfied.

The Russians are already doing something of the kind. They are armour-plating the hull of some ships of about the "Raleigh" class, and placing a narrow band of additional armour in front of the gun-pivots, but they intend apparently to employ these ships against unarmoured ships only. If they fulfil the intention of their designer, they will have a manifest advantage over unarmoured ships, and if they have sufficient speed to bring the unarmoured ship into close action, their chances of destroying her will be considerable. But suppose two such ships, both protected in the same way, should meet, we should then probably have a *close* action between them, for, being equally protected, they would not think it creditable to avoid an engagement. We are thus brought by another road to the point we had reached ourselves, in which we have a close engagement between two ships having armoured hulls and unarmoured batteries.

I believe that the contest between broadsides and turrets will settle itself eventually in this way. The increase in the power of ordnance will drive us to thicker armour, and we shall concentrate it upon the only vital parts, viz., the floating and the motive power.

The Chairman: I hope that some gentlemen present will give us the benefit of their opinions upon the points raised by Mr. Barnaby in his very interesting lecture. From the trials that took place with the "Hotspur" against the "Glatton," there is no doubt that the shot from the 25-ton gun, at that very short distance, was brought up by the turret of the "Glatton." But the chief point that we all wished to have decided was, whether a shot coming in just above the flange of the turret on the deck, would stop the working of the turret. Now that second shot fired did not stop the working of the turret, because it was fired at so short a distance point-blank; the shot being a pointed shot it naturally did not turn down,

but went straight in. But if that shot had been fired from a height, or at any ordinary distance, 500 or 600 yards, it would have had a small elevation, and would have struck the mark with the point rather inclining downwards. Probably that would have altered the question entirely. If the point had been turned down it might have shown a very different result. With regard to the turrets, it must be borne in mind that in firing against a turret you always get a direct shot. If you are near enough to hit your mark, your shot is always a direct shot. But it is not so in a broadside ship; you never get a direct shot without you are broadside on. With the turret it does not matter how the ship's head is: if you are near enough to hit the point you aim at, you will always get a direct shot. Consequently the turret is at a disadvantage in that respect.

Commander W. Dawson, R.N: My lord, as I have been alluded to in the paper, I venture to rise to open the discussion. Those of us who had the advantage of hearing Mr. Barnaby's former paper in this Institution, came here with very large expectations as to what we should learn, and I think I am expressing their feeling when I say that we are not disappointed. A more able and, if I may say so, a clearer and more dispassionate paper I do not know that I have ever heard in this Institution. With the mass of the lessons drawn, I thoroughly concur. I am particularly thankful to find that the Controller's Department of the Navy have come at last to the conclusion that ships are built to carry guns; because the offensive powers of successive types of ships have been gradually dwindling down to a vanishing point. Whilst the "Northumberland" carries 261 tons of ordnance, the "Sultan" carries but 194 tons, the "Swiftsure" and "Vanguard" classes 139 tons, and of the two ships experimented upon at Portland, one, though of 4,800 tons, mounts but two guns of the united weight of 50 tons, and the other ship, though of 4,000 tons, mounts but one gun of 25 tons weight. That offensive power is now to be considered as of some importance is, I think, a very satisfactory conclusion. It is very gratifying to find that in future our ships are to have a fair proportion of guns to fight with.* I thoroughly concur with the conclusions of the lecturer that the great defence of all ships is the ability to hit your enemy pretty hard and often, and, if you hit him hard and often, I think you may withdraw from the gunners some of their present armoured protection. Still, I think the gunners do want a little protection, and I look rather aghast at those bow and stern guns mounted up in the air without any covering whatever, when I remember that small arms can be sighted for pretty accurate practice at 900 or 1,000 yards, and that all good naval actions must be fought certainly under 1,500 yards. Therefore I think I should like to see light cover of some kind. (Mr. Barnaby: There is.) If you would only put a canvas screen round those tower guns, I should be very thankful for it; I mean a cover from sight rather than from shot. The broadside guns must be used at close quarters, and under all conditions of action, and require, therefore, more substantial cover. But the absurdity of putting a small patch of 14-inch armour a few feet square, and then shutting your eyes like the ostrich, and fancying the enemy is going out of his way to aim specially at that small 14-inch patch, was very clearly shown to those who witnessed the difficulties of hitting the turret at Portland. Our naval architects have laboured hitherto under a very great disadvantage in devising the novel structures of the last few years. They have been deprived of the advantage of intelligent external naval criticism as they have gone along. They have been obliged not only to construct the ships, but almost to tell naval men how to fight them. Being without this cultivated, intelligent, independent, and experienced professional criticism, external to the Admiralty, which they have a right to expect from the navy, they have been obliged to go, as it were, out of their own department of constructing a ship, and we must not be surprised

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* This observation referred to the admirable principles enunciated by Mr. Barnaby, not to the design of the new ship exhibited on the walls. The new ship is designed to carry only 158 tons of ordnance, whereas even the old "Warrior" carries 202 tons of artillery, and the "Northumberland," 261 tons. So that, as to powers of attack and defence, the latter vessel would be much preferable, if her weight of ordnance were only concentrated into fewer perforating pieces.—W. D.

if there have been some mistakes as to the fighting capabilities. On the other hand, we must acknowledge, as naval men, that if we have given very little assistance to architects in the construction of our ships, they have at least succeeded so well in the generality of them, that the whole world is coming to England in order to copy the designs of British architects. Now, my Lord, I shall be expected perhaps to say something as to the "'Hotspur'-'Glatton' Experiment," having read a paper at another scientific institution on the same subject. Of course British armour is intended to meet foreign guns; and foreigners, though so ready to copy British ships, do not copy British guns. It will, then, naturally be asked, "But what will foreign guns do as compared with British guns?" My answer is that we do not know. All the information I can get with reference to foreign guns comes filtered through a very suspicious source, and I am not prepared to believe all that is so said, without an examination of more reliable data. The Germans appear to me to be a very intelligent warlike race, and not to be a very moneyed people; and I suppose they know a good weapon when they have tried it, and I do not imagine that they would pay double the price for guns which have only half the endurance and do half the work which ours do. Captain Maitland, the able Deputy-Superintendent of the Royal Gun Factories, stated at the Civil Engineers' Institute last year, that "the object kept steadily in view by the authorities was to get the highest possible velocity out of a gun with the heaviest possible projectile, or, in other words, to get through the thickest armour-plate at fighting distance, that is at 1,500 yards. But the late Ordnance Select Committee, a very intelligent body of experienced officers, reported that the present guns have "decidedly the lowest velocities." Now, the penetration of a given armour-plate is a matter of the weight of the shot multiplied into the square of the velocity. Perforation is a question therefore of mere calculation. Before going to Portland at all, artillerists could have told that the shot could not possibly have got into that turret. When at Portland I had the opportunity of speaking to some of the ablest artillerists of the sister service, and all that they prophesied concerning the shot, took place; so that we may be assured that their figures are very tolerably correct. Now the velocity of impact required to go through that 14-inch plate and backing, was 1,332 feet; the velocity lost in the 200 yards that the shot had to traverse in passing through the air was 25 feet; therefore the initial velocity required was 1,357 feet. The actual velocity the shot was supposed to have had on leaving the gun was 1,300 feet; there was therefore a deficiency in velocity of 57 feet. Take it in foot-tons: the striking force required by a 12-inch shot to perforate that turret was 7,378 foot-tons; the actual striking force was 6,788 foot-tons; therefore, there was a deficiency of 590 foot-tons. The penetrating figure required to perforate that target was 197; the actual penetrating figure of the 12-inch 25-ton gun was 188 on leaving the gun: there was a deficiency therefore in the penetrating figure of 9. How is it then that our guns have "decidedly the lowest velocities," as is officially reported? The most obvious reason of these "lowest velocities is because they are fired with the lowest charges; instead of having 95 lbs. of P. powder which we know a 12-inch bore can consume very fairly; another 12-inch bore has consumed 120 lbs., and does consume regularly 110 lbs. P.; the "Hotspur's" 25-ton gun only consumed 85 lbs. P. But not only have our guns the lowest charges, they have also the "lowest velocities" when firing the same charges; for that is the condition to which the Ordnance Select Committee referred. I do not think that Mr. Barnaby gave an artillerist's reason for that inaccuracy of fire to which he alluded. I speak in the presence of a good number of very experienced naval gunners, and I think they will agree with me that, as there was an average of half an hour between each shot, and the "Hotspur's" gun was fired by the most skilled marksman in the "Excellent,"—the man who conducts all their experimental firing,—the seventh shot should have been at a distance of 200 yards in such smooth water with only one degree of roll, more accurate than the first, whereas every shot was pretty equally inaccurate. The inaccuracy was very slight. I would not call it "inaccuracy," but "irregularity." Now that irregularity of flight was perfectly well known to every artillerist present at Portland. We discussed its cause and its amount on the way down in the train, and during the progress of the experiment. It is stated in the "Official Blue Books" and "Text Books," and in "Modern Artillery. The reason assigned

for this irregularity of flight is, that the shot does not centre itself in the bore, and is not truly or sufficiently rotated. This explanation is not an invention of my own, but the cause assigned in the official "Blue Books" and publications. The Navy is obliged to take all its knowledge of the 25-ton gun at second-hand from military publications, as its Officers have little or no experience of their own as to this gun or as to the 35-ton gun. How are these "lowest velocities" to be accounted for? The lost velocity is taken up in destroying the projectiles. Only to-day the "Times" has an account of a Palliser shell, which had been fired from a 25-ton gun, having exploded in an immense cupola at Woolwich, whilst being recast with a large quantity of once fired projectiles. What does that recasting mean? Why, that every projectile that leaves a Woolwich gun is so injured in the effort to get out that they are obliged, if it is recovered, to return it to Woolwich, to bore out every stud, and to place it in the furnace, and to recast it. In this ordinary, but most expensive, process, a Palliser shell of the 25-tun gun happened to be loaded, and exploded accidentally. Happily, "Woolwich" shells contain a very small quantity of powder, and the explosion did not do very much harm. If Woolwich guns have "decidedly the lowest velocities" and decidedly the least perforation, there must be other reasons also. It must be remembered that when similar charges of powder are exploded in identical bores with like weights of shot, the same amount of explosive or expulsive force must be developed. If then a short rifle-bearing produces "decidedly the lowest velocities" when compared with a long rifle-bearing in similar guns, what becomes of the missing expulsive force? If that expulsive force is not carried out of the gun by the shot, it must be used up in the bore and communicated to the walls of the gun and projectile. We know that it is used up partly in the destruction of the projectile, and partly in marking and injuring the interior of the gun. There are only three ships which carry these 25-ton guns, the "Monarch," the "Hotspur," and the "Glatton." Not one of these ships is in commission, and when they were in commission, no steps were taken to acquire naval experience as to the endurance of any one of their 25-ton guns when fired continuously and with elevation, for a few hours together. Not one of these 25-ton guns has fired in naval hands a hundred rounds altogether. All our knowledge of them is of a second-hand character, and derived from the study of military publications. I say this publicly, and challenge the authorities to fire 100 consecutive rounds with mis-called battering charges and 2° to 5° elevation from the 25-ton gun. Why, on earth, are these heavy guns treasured up and only allowed to fire diminished charges at low elevations with long intervals between? If they are too fragile to stand proper charges, to be fired with elevation, to go through the continuous and comparatively rapid discharges of a naval bombardment, surely the Navy ought to know it. And the Navy itself ought to try one of them at it, and not trust to second-hand knowledge, which does not include such an ordeal. Here is a special nature of gun which has been afloat three or four years, and yet the Navy does not know by its own experience whether they will stand an ordinary naval battle. I say, that there is no evidence that the 25-ton or 35-ton guns will stand an action at sea, even with the diminished charges to which we are compelled to resort. Ought not the endurance of these guns, which "have decidedly the lowest velocities," to be tested by the Navy? Are seamen gunners incapable of testing a gun? They could be tested at very little expense. Let the "Glatton" be attached to the "Excellent," as was rumoured to have been done last year, as a tender, and take the place of the "Staunch," "Stork," "Royal Sovereign," &c., and let each seaman gunner fire his ordinary five rounds of training practice from one of the "Glatton's" guns. Don't let a single round of training practice be fired at Spithead by the seamen gunners from any other gun for a single year, and before the end of the year, the Inspector of Ordnance will have registered such internal injuries that you will have to re-arm the "Glatton." There is nothing unfair in such a trial. It would be, after all, but a mild ordeal. They could go out to Spithead. The seamen gunners do not fire at Spithead more than some 30 to 50 rounds per week. There would be little extra expense, save perhaps in the matter of coals; but that could be economized, as one or two boilers would do all that is required for target practice. Therefore, I do not think there need be any difficulty on that plea. But surely one of these 25-ton and 35-ton guns ought to be practically tried by naval artillerists.

They ought not to be stored up in tallow and tow until a maritime war breaks out, without the Navy having fairly tested one of them. What harm can happen from such a trial, if these guns are "the most magnificent guns" in creation! the "most powerful guns in the world"! which have "never burst explosively on service"? Where have these heavy "Woolwich" guns ever fired a shot "on service"? I am sorry to have travelled beyond my text, but we cannot discuss the "'Hotspur'-'Glatton' Experiment" nor the ironclad ship of the future, without giving some consideration to the circumstance that the guns "rifled on the French (or Woolwich) system have decidedly the lowest velocities," and therefore the least perforation and the least endurance.

The CHAIRMAN: I suppose you do not mean that the guns would burst, but that they would become unserviceable in a very short time?

Commander DAWSON: It comes simply to this. As the gun is repeatedly and rapidly fired with heavy charges and elevation, it gets roughened in the wide, deep, empty, upper grooves and lands. The more rough it gets in the inside, the more obstrucions occur in the way of the gun-metal studs when going out, and then arises what are called "local injuries." Those local injuries amount in time to the cracking, fissuring, enlarging, and burning, of the interior, and to the disabling of the gun. The injuries may not constitute a permanent disabling, but it will be quite enough to compel British ships to cease firing in the heat of action. If compelled to cease firing, and your speed is not sufficient for running away, the British flag must be struck. The ship will then be towed into an enemy's port. That enemy can then bore out the damages and put in a new steel barrel and a mechanical system of rifling. He can then send that captured gun to fight against British ships, with the certainty that it shall not give way again.

Captain COLOMB, R.N.: I am sure there must be many naval men here who could speak to this question with much greater force and ability than I can. But on Mr. Barnaby's reading his last paper here, I felt it my duty to convey to him personally my thanks for giving us in small compass that information publicly which we could get in no other way; and I wish again to thank him to-night for giving us the salient points of the experiment between the "Hotspur" and the "Glatton," which no amount of reading would put before us in the same small compass, striking our thoughts in the same way. The immediate remedies that he proposes to apply to the defects which were found in the "Glatton's" turret must, I think, commend themselves to every naval officer who has looked even cursorily into the question. Any person who has watched the trials at Shoeburyness, must have always looked with some sort of terror upon the enormous crop of rivet-heads which flew to the rear. And although those rivet-heads, as Mr. Barnaby has said, seldom flew to any distance, yet there was always the doubt how far they would fly, and, it appeared to one looking at the rear of the target, as if the rivet heads formed a sort of projectile which might on occasion be very destructive. Looking at it in the hurried way in which one does on an occasion of this kind, the remedy applied by means of screws seems to be quite perfect: it appears as if there could be no discharge to the rear in the former way. Then the placing of the bolts out of the turret, practically at least, the upper one out of the turret and the other one protected by the glacis plate,—that also saves us from the flying of the bolt-head; and I wish to confirm Mr. Barnaby, having looked at the turret myself after the shot was fired, in saying that there was really no damage visible inside the turret, except that which was done by the flying of the bolt-head. That, I think, would have been very serious to the gun's crew, taking the course that it did. On the general question that Mr. Barnaby brings before us, I must own that he echoes the thoughts that have been in my mind for a considerable time, and, I believe, in a great many naval officers' minds,—we have thought that we have been unduly sacrificing our offensive power for a presumed value of defensive plating, while at the same time our real defence in a turret was, as Mr. Barnaby has distinctly put it, the difficulty of hitting the object. So that practically it was only necessary to protect a turret from an enemy who chose to bring against it a large number of light guns. Your danger was not that the enemy would attack you with a small number of very heavy guns capable of penetrating heavy plating, but that he would bring a large number of moderately light guns, and be able to hit the turret, simply because of the number

of the shot that he fired at it. But if you put a moderate amount of plating on the turret, supposing you adopt the turret system, you guard yourself against such an enemy; and supposing that your enemy brings a small number of heavy guns, your guard then, as Mr. Barnaby has put it, is the smallness of your target. With his general conclusions, as to the future of the guns and armour, I must say I am strongly disposed to concur.

Captain HOSEASON, R.N.: Not being here at the early part of the meeting, I should like to ask Mr. Barnaby one question: is that turret a protected turret, or only just flush? (Mr. BARNABY: A barbette.) A barbette,—nothing more! The question, then, I presume, that you are propounding to us is, "How would you like "to be killed? Would you like the moral probability of being killed in a turret, "or of being drowned?" You propose an armament which many people might suppose would increase the chance of the men at the guns being hit, and you make the ship's side more invulnerable to secure us from the moral probability of being drowned. If that is the way in which you put it, I must say I am from the very first with you; I would rather fight the ship with no chance of being drowned than with the chance of not being struck in the turret. I should take the area of the ship, and, taking the chance of hitting the turret and the chance of hitting the ship, I should come to the conclusion that I was infinitely safer in a ship that would float, without a turret, than in a turret fortified in the manner of our turrets at the present moment. If splinters are knocked about by a ball penetrating the turret, there is no chance of escape. Do I understand your proposition to be that you would add strength to the hull with a view to ensure its not sinking if the ship was struck? (Mr. BARNABY: Certainly.) Your proposition, then, is, "Shall I fortify the hull and make it invulnerable, or shall I bestow "more strength upon the turret and labour to make that invulnerable?" (Mr. BARNABY: Quite so.) Taking that view, I must say I would rather be secure against being drowned.

The CHAIRMAN: Are those intended for turrets in the bow and stern?

Mr. BARNABY: They are barbette turrets. This (pointing to the plan of the deck) is the shape of the turret fixed upon the upper deck. There is an armoured screen round it seven feet deep. There is a turn-table inside for the gun, and a protected means of communication for the ammunition. For the protection of the guns above the turret, you see there is a light framework of iron; on that is a mat-screen over the top and round the sides, dropping down to nearly the top of the fixed part of the turret. That is planted upon the turn-table, and revolves with the gun and slide, so that the gun is always pointing out through the opening in front of this mat protection, which, if it happened to be damaged by a heavy shot, could be pitched overboard.

Captain HOSEASON: You said seven feet was the height of the armour: the battery is open at the top; it is not protected at the top at all.

Mr. BARNABY: Only by the mat.

The CHAIRMAN: What is the height of the guns from the water-line? These are 25-ton guns, I suppose?

Mr. BARNABY: That is a 25-ton gun, and the muzzle of the gun would be about 24 feet out of the water. The drawing represents a ship of 285 feet long, and of a little over 8,000 tons displacement. It is a drawing of a proposed plan; we have nothing of the sort at present. The vessel will have two masts and a bowsprit. The funnels are placed one in the foremost main-deck battery, and the other in the after one.

Captain GOODENOUGH, R.N.: I suppose that one of Mr. Barnaby's objects, in reading the paper, has been to elicit opinions, either *pro* or *con*, to his propositions; and, although I have very little to say and nothing new to offer, I think it is due to him that those opinions should be uttered in this theatre. Therefore, I wish to bear my testimony in entire approval of almost everything Mr. Barnaby has said, and especially of the design which he has put forward; and I must further say, that we are greatly indebted to Mr. Barnaby himself, who, we all know, has been suffering from sickness lately, but who, nevertheless, has given himself the trouble of coming here. We are also greatly indebted to his department and to the Controller of the Navy, for having allowed these drawings to be put before us. I have had the

advantage of being recently in France, and I, therefore, may be in a position to explain to the meeting some of the peculiarities of the French ships which carry these barbette *towers*, as we may prefer to call them, in opposition to *turrets*—upon their decks. The French ships have a battery which, we may say, is more or less like that (*vide* drawing) on the main deck, and the towers which they carry are on the upper deck, on the four angles of the battery, projecting slightly from the ship's side, so that the two foremost guns get a fire almost right ahead and to a considerable angle astern; the two after guns almost right astern and a considerable angle ahead; the rigging of the foremast and mizen-masts being brought down to plates, tied under the main deck beams. There are drawings to be seen of one such arrangement of the battery, in the *Revue Maritime* for last July or August, with a very excellent memoir, by Captain Baron Grivel, who commanded the "Océan." I have met a great number of Officers of the French Navy who have commanded these ships, and, without a single exception, they expressed themselves most entirely satisfied and pleased with the barbette guns. They speak particularly of the very large offensive power that it gave them; that it not only gave them a large arc of fire, but I was very glad to note that they dwelt upon the possibility of seeing the enemy, at the points of your sights the whole way round, even when you had an obstruction in the shape of rigging which prevented firing, instead of having been at one moment hidden from you by the superstructure forward, and the next moment suddenly appearing in sight, through a narrow port, where your eye is almost blinded with light, and where you are not in a position to recognize the presence of an object till it has been for some seconds within your range of view. (The CHAIRMAN: Where you cannot take any sight at all, in fact.) Of course there is a disadvantage in sustaining a close action, at fixed distances, and in a single spot, in a ship with such barbette towers, and I think that this points out the necessity of our having distinct ships for that particular service. That is to say, you engage a battery and you are going to anchor at a fixed distance from that battery, and to engage it for any length of time; it is evident that for such a purpose you must resort to the closest armour-plating you possibly can have, and that you must protect the men who are going to work the guns, otherwise they will very soon be put out of action and your vessel may be obliged to move, or will have to be supplied with fresh men. But where you have a sea-going ship of that description, there is no reason whatever, so far as it seems to me, why you should not discard all that weight of armour which you carry about the gun, for the defence of the crew, and employ it either to increase your speed or to increase your coal-carrying power, or the armour on the belt. In this particular design, there is one other little point which, I think, is a great advantage, and that is, that traverse which crosses the deck, between the two guns, firing right ahead and the two broadside guns. There certainly was a great objection to the port, as it exists in the "Hercules," and, I think, in the "Sultan," that if a shot or shell ever did pass through that angular part, it would probably injure the whole battery of guns, more or less; whereas, with that fitting at present, you have such a distinct defence for the two after-guns.

The CHAIRMAN: Might I ask you, did you inquire what the French did with these barbette guns?

Captain GOODENOUGH: That would take us into a history of the French operations on the German coast. The French ships were so large that, as you know perfectly well, they were not able to approach it. They draw so much water, from their not having attended so much to that point as ourselves, that they are even in a worse position than we are in that respect. The only thing which they did show, was their great capacity for keeping station, and for being always in the right place, so far as they could be, at the right time. The German Admiral, who commanded at the Jahde, told me he admired exceedingly the way in which the French Fleet appeared at daylight in the morning, every ship being exactly in station; and when we come to reflect that that French Fleet was fitted out and sent to sea in about twenty days, and from reserves of seamen and Officers, we may well ask ourselves whether it is in our power to do the same thing; whether we have sufficiently instructed Officers and sufficiently trained men, and a sufficient number of ships in reserve, to send out two powerful Fleets in so short a space of time.

Captain R. A. SCOTT, R.N.: It is impossible to do justice to or to fully discuss an im-

portant paper of this kind, on hearing it for the first time. But if I am permitted to give a paper to the Naval Architects, I shall propose to give my views from a gunnery point entirely, as to the lessons to be gathered from the "'Hotspur'-'Glatton' "Experiment." I will, therefore, pass to the vessel which Mr. Barnaby proposed, in the latter part of his paper, which has so many points of excellence that I am afraid I shall scarcely be able to do it justice. From the cursory glance which the short time admits of one's taking of the design, it would seem that there are a great many points worthy of further consideration, such as the height of the guns out of the water, and other details. But, on the broad scheme, there can be no doubt of its superiority over anything that we have at present. We have, in this design, powerful guns shown at the bow and stern, with regard to which there is a great deficiency in many of our vessels—a deficiency which, I think, ought to be remedied. Not only so, but if one of the protected gun-batteries is disabled, we have, in this plan, other protected gun-batteries with which to continue the action; there are really four separately protected batteries, for, in each, the working portion of the gun is protected by armour-plating. It is, perhaps, hypercritical to say that I should myself prefer one 35-ton gun, instead of two 18-ton guns, on each side of the largest battery, because the power of a 35-ton gun, to penetrate armour at an acute angle, is very much greater, in proportion to weight, than that of an 18-ton gun. And one heavy gun is really better than two lighter guns, because the smoke of the one gun will mask the firing of the second gun; and if you fire two 18-ton guns together, they are still inferior in effect to one 35-ton gun. The weights being the same, in both cases—one 35-ton gun in lieu of two 18-ton guns—would require far less length and would, consequently, enable Mr. Barnaby to shorten his battery, and possibly to make use of the armour thus saved for covering another gun, in some other part of the ship. He has not shown any light guns on the upper deck, but as the supposed advantages of a larger number of light, in lieu of a few of the heavy guns, has been lately dwelt upon, I think it necessary to point out that a larger number of light guns would be really of no advantage, because the smoke from the lighter guns would hinder accurate aim from the heavier guns. The smoke hangs about the vessel firing, and renders it impossible to get off even two or three guns successively without obscuring the view. It is, therefore, a fallacy to imagine that you will ever do greater execution with a number of light guns than with fewer and heavier guns. In respect to hitting accurately, a heavy gun is really more accurate than a light gun, and, therefore, there would be no advantage, in that respect, for the latter, nor can I see any good reason whatever, for going back to mounting, in any of our vessels, a number of guns which are too small to pierce armour. We certainly want, for some purposes, a proportion of light guns; but all our vessels, whether armoured or not, ought to mount plate-piercing guns, so as to be able to engage, instead of running from, the enemy. I believe the preponderance of offensive, rather than of defensive, power will always tell in an action, and that the offensive power, say of one of our largest unarmoured frigates (the "Inconstant"), which would carry five 12-ton guns on each broadside into an action, might decide it. Therefore, I hold that an unarmoured vessel should mount plate-piercing guns, and such a vessel gives the means, as Mr. Barnaby's arguments have so ably shown, of carrying heavier guns than in an armoured one, because, when you dispense with the armour, the ship is able to carry much heavier weights in guns, &c. I believe that this is the direction, viz., of heavier guns, in which we shall have to go. At the present time, as regards heavy guns, I fear that we are really much behind in instructing the hand and eye of our seamen-gunners to use them. I think it is a great mistake to set out with the notion that you cannot get a far higher degree of accuracy than is now obtained. We gunners know perfectly well, as Captain Dawson has truly said, that, in the case of the inaccuracy of the firing at Portland, it was not due to aim, but to the inaccuracy of the flight of the projectile. If you commence instruction with an inaccurate projectile, your men will not succeed in getting any very great amount of accuracy afterwards, from heavy guns. But given an accurate projectile, a keen eye and hand, with proper encouragement to stimulate the skill of the men, then, I believe, they would soon learn to fire at sea nearly as accurately as is now done on Wimbledon Common. I speak from having had great experience in gunnery training, with firing at sea, under all cir-

cumstances, and I, therefore, venture to think that Mr. Barnaby has rather overstated the difficulties of hitting the mark at sea. At first sight, one would say, if such a thing were not done daily, that a man would never be able to shoot a snipe, and yet you know how truly the sportsman's hand and eye go together. A skilled gunner would, in like manner, intuitively feel when his ship was going to roll, and would know how to allow for it. It does not matter whether a ship is down in the hollow or up on the top of the wave, as long as your gun is laid fairly on the mark, for it would only have a slightly different angle, which could be allowed for perfectly. What we should therefore most aim at, at the present time, is to instruct our men more fully, and then, I feel satisfied that we should soon have guns also which would give that accuracy of fire which was not obtained in the "'Hotspur'-'Glatton' Experiment," and which the "'Hotspur'-'Glatton' Experiment" showed there was such a deficiency in. But, as I propose to read a paper specially going into the subject of the erratic flight of the shot then fired, and how, but for that erratic flight, it would have penetrated, I will not dwell further upon the experiment, but only say, there were three causes that prevented the projectiles penetration through the "Glatton's" turret; first, the studs which had to be sheered off; then the erratic flight which caused it to waste its force in making a larger hole than necessary; and, thirdly, its low velocity. If there had been a truer flight, I believe the projectile would have gone through; or, if it had had a higher velocity, even coupled with the erratic flight and the retardation caused by sheering off the studs from the projectile, it would have gone through. Therefore that experiment, as it appears to me, must condemn our present system of artillery, in the minds of all intelligent naval gunners.

Captain Field, R.N.: I should like to ask one question with regard to the ship that Mr. Barnaby has submitted to us. Whether he has paid any attention, in the construction of that ship, to the possible action of torpedoes? Whether there is any alteration made in her internal structure to guard against such fearful weapons as I have seen lately? The other day I saw, with wonder and amazement, the action of the Fish Torpedo which, immersed five feet, went 400 yards down a canal, at Woolwich, in a perfectly straight line, and it struck me that the days are coming probably, when, instead of flattering ourselves that we have made our hull perfectly safe, and that there is no fear of our being drowned, we may have to go back to small ships and discard armour altogether, endeavouring, if possible, to guard the bottoms of the ships, instead of merely protecting our engines and our guns.

Commander Dawson: I should like Mr. Barnaby to explain to us the results of the concussion between the "Northumberland" and "Hercules" the other day.

The Chairman: I would just put one question myself. The vessel that you have now laid before us carries 25-ton guns, and the guns are 25 feet out of water? (Mr. Barnaby: Nearly that.) Because the vessels that we have had before us, and about which we have been anxious, are vessels such as the "Glatton" and "Hotspur," with a gun down nearly at the water's edge. Perhaps you would have the kindness to explain why, if one set of vessels are supposed to be the right thing with the guns at the water's edge, you are now going up 24 feet? If I am not mistaken, I measured the "Sultan," when I was down the other day at Portsmouth, and her forecastle was 32 feet out of water.

Mr. Barnaby: This drawing of the ship I place before you to-night with the object of illustrating the "barbette-batteries," and not as an official design, because I hoped there would be a little freer answering of the questions which seemed to be rather difficult, and which appear to me to have been avoided. Perhaps those gentlemen who are here will think them over, and in course of time we shall get to know whether we are to go on protecting the guns and gunners, or whether we are really to prevent the ship from being sunk. I have not gone very fully into this design, and I am not at liberty to say anything more about it than I have said. To complete my description I should say, that to protect the engines and the ship herself to a certain extent from the action of torpedoes, this ship is divided by a fore and aft bulkhead, which separates propellers, engines, boilers, and bunkers, and everything connected with propulsion, into two parts, so that there are two independent and complete sets of propelling apparatus. Captain Dawson made a remark which I think was not quite fair: he said that naval architects were left

pretty nearly alone in considering these matters, and that we have not the intelligent criticism of naval officers. I must say (and if any one should know, I should know how that matter stands) that no naval architects could have been better helped than the naval architects of the Admiralty have been by the late Controller of the Navy. (Captain Dawson: I mean external criticism.) And certainly the novel features in the ships being introduced now, are due quite as much to the present Controller of the Navy as former ones were to the late Controller. If the Controller had not done me the honour of being here to-night to hear my paper, I might say more on this subject.

Admiral Houston Stewart: If there is anything that Mr. Banaby thinks would interest this meeting in connection with that design, I am sure in his official capacity he is quite at liberty to say anything he thinks proper. Perhaps it may simplify matters if I say that that ship has been approved of by the Board of Admiralty.

Mr. Barnaby: This diagram (Plate XIV, fig. 3) shows, as you will observe, the manner in which the side of the "Northumberland" was penetrated by the ram of the "Hercules." You will see that the further passage of one ship into the other was stopped by the armour; that the ram just caught under the under side of the armour. I think the position of the ram has been very well managed, and I think that the defence of the ship has also been very well managed. This space, cut off by the bulkhead which you see here, is so subdivided that although the blow was on a division here, there was only a small compartment that filled with water, and the damage was very speedily repaired, as you know; in fact the ship was as well able to fight immediately after the damage as before.

The Chairman: I think you will agree that we are very much obliged indeed to Mr. Barnaby for the very interesting and very useful lecture that he has given us, and the many points that he has brought before our notice which are of the greatest importance on these subjects. I hope Mr. Barnaby will before long give us another lecture not only upon the trial of the "Hotspur" and "Glatton," as to their guns and armour, but upon their trials as sea-boats.

TARGET FOR EYE-TRAINING.

By Captain F. H. Poore, R.M.A.

Before I commence to explain this apparatus, I must ask you to allow me to trespass upon your patience for a short time whilst I say a few words upon a subject which has been touched upon by several gentlemen this evening, that is, the necessity which exists that our seamen and gunners should be more carefully trained in firing at objects from rolling ships.

We must not lose sight of the fact, that the sole end and aim of our profession, and at which we are all driving, each in our own particular line, is to keep our service in such a state of efficiency, and so to organise and train the men under our command, as to be capable of inflicting the maximum amount of injury upon the enemies of our country, whenever the time may arrive for us to do so: I think it is generally acknowledged that the gun is our principal weapon for accomplishing that object.

With this end in view, we have been supplied with the most effective guns and the best form of projectiles which the skill of the gunmakers and the experience of artillerymen can produce; they are mounted for

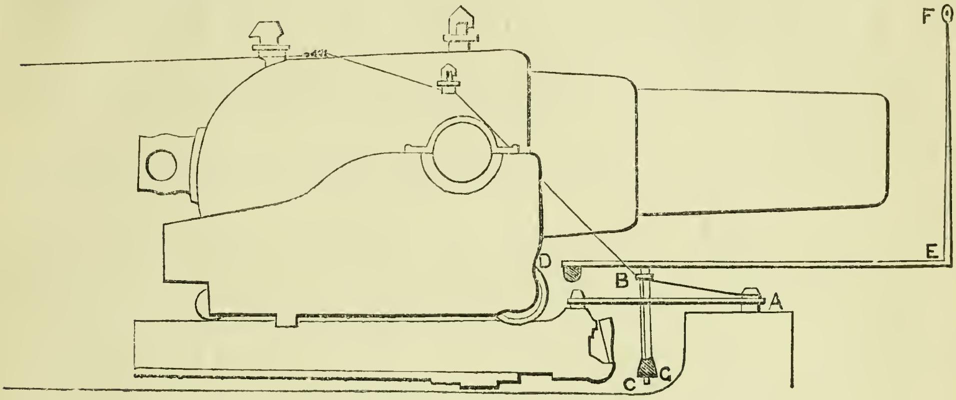
us upon carriages and slides which are models of inventive genius, and much time and labour is spent in training the guns' crews to manœuvre these guns, carriages, and slides with rapidity and precision. All this is done for the sake of placing in the hands of the Captain of the gun the best weapon, and giving him the means of placing that weapon in the best position for delivering his blow upon the enemy. But if, at the critical moment, from any want of practice, the Captain of the gun fails in his most important duty, then the skill and experience of the gunmaker and the artillerymen, the inventive efforts of the carriage-contriver, and the time and money which have been spent upon the training of the guns' crews, are simply thrown into the sea. If we refer to our naval history, we shall find that, in the few cases in which we have failed to gain victories, our failure has been generally attributable to the want of accuracy of the gunners of that period, and men were warned by events to pay more attention to that most important point in their training.

For many reasons the importance of attention to this point of training has vastly increased in the present day. In the first place an iron-clad under steam will roll heavily when a wooden ship under sail will be comparatively steady, and the difficulty of striking the object being so much increased, a more persistent practice is rendered necessary. In the second place, in former days when a ship carried fifty or more guns on a broadside, if one man missed, another would probably hit, and there was every chance of a certain per centage of shot being effective; but now, when some ships carry but two monster guns, it is placed in the power of one man either to do a crushing damage or to throw away a whole broadside.

Seeing then that the captain of the gun has such a heavy responsibility, the necessity of his being most carefully trained forces itself upon us, and it is our duty to consider what means we possess for carrying out that training. At gun-drill in sea-going ships, when there is no object in sight, it is the general practice to warn the men to fire when the sights are brought on with the horizon by the rolling of the ship. But any one who has had any experience knows how impossible it is to get the men to do this, unless an instructor be placed to watch every gun. A man sees no visible result in his being so extra careful, and probably no one knows whether he has made a good shot or a bad one, and, whilst he is conscientiously trying to get his sights on with the horizon, the captain of the gun next to him has fired his shot at the moon, has run his gun in, and half way out again, and is gaining the credit of being the smarter man of the two. There is an old fashioned plan, which I believe is seldom used now, of running a gun fore and aft the deck, and pointing at the old lever target. I think that apparatus is calculated to do the men more harm than good, as its motion is as much like the apparent motion of a target from a rolling ship as the motion of a Catherine-wheel is like that of a pump-handle, and the men, disregarding altogether the sights on the gun, soon get to know when the corner of the target is coming in line with some part of the ship, when they pull the tube-lanyard and make bulls-eyes with unerring certainty.

The only other means, as far as I am aware, that we possess for training men in firing from a rolling ship, and testing whether they be good or bad shots, is by actual practice from a ship at sea; but this is such a very expensive luxury that it can only be indulged in by a select few.

Having enumerated the various methods of eye-training at present existing in the service, I will proceed to explain this very simple apparatus, and leave you to judge of its value for the purpose for which it is intended.



An iron bar, A B, is shipped on to the pivoting-bolt on the lower port-sill. There is an universal joint at B, from which a rod, B C, hangs perpendicularly between the pivoting-bars. A wooden frame, D E F, is rigidly fixed to B C, so that any motion of B C gives a corresponding motion to D E F, and consequently to the small target at F, which appears in line with the sights above the muzzle of the gun. A weight, G, free to slide up and down the rod B C, is held up by a line, which goes round the trunnion-sight and is attached to the tube-lanyard in such a way that it slips when the tube-lanyard is pulled. The action is as follows:—

The rod B C, and consequently the frame D E F, swing freely with the rolling and pitching of the ship. When the captain of the gun gets his sights on with the target, he pulls the tube-lanyard. The line supporting the weight is let go, the weight falls on to the deck, and being there held by small spikes placed in the bottom of it, stops all motion of B C and D E F, and the target F remains in the same position it was in when the captain of the gun pulled the tube-lanyard, and shows whether he has made a bulls-eye, centre, or outer, or whether he has missed the target altogether.

The apparatus can be trained on the bow, beam, or quarter, and it in no way interferes with the regular drill, except that No. 2, in addition to his other duties, would have to attach the line to the tube-lanyard.

The CHAIRMAN: What size would the target be for an 18-ton gun? and is it outside the port?

Captain POORE: This one I have used with a 7-inch gun. The arm comes through and outside the port, and up in front of the muzzle of the gun.

The CHAIRMAN: Have you tried it with the small ports and the large guns, with the 18 and 25-ton guns?

Captain POORE: I have only tried this with 7-inch guns in a frigate.

The CHAIRMAN: Why I ask the question is, you can hardly see anything out of the port of the turret when the gun is run out, and it would be rather difficult to catch that target.

Commander W. DAWSON, R.N.: In what ship has this target been fitted? and has it been tried in the channel squadron?

Captain POORE: In the "Galatea." One has been sent to the "Minotaur," by order of the Admiralty, but I have heard nothing of it since.

The CHAIRMAN: It appears to me if one of the old guns was run in on deck, pointed fore and aft, and the target stuck in front of it, it would answer admirably. If you stick it outside the muzzle of an 18-ton gun with a small port, there would be some difficulty in catching the object.

Captain POORE: This can be fitted to a gun without interfering at all with the working of the gun: it is capable of being trained in any direction, either on bow, beam, or quarter.

Captain SCOTT, R.N.: An Officer who was present in the "Galatea" informs me that it answered perfectly, and that it has been reported as having done so at the Admiralty.

Commander DAWSON: I must first of all congratulate Captain Poore on the rare opportunity he has had of explaining this admirable invention in the presence of Lord Lauderdale, because no officer has done more to promote eye-training than his Lordship. Lord Lauderdale, when Captain of the "Wellesley," paid great attention to this most essential art of eye-training. I had the honour of serving under your Lordship's gunnery lieutenant and the present Admiral S. W. Jerningham, when he commanded the gunnery ship "Cambridge," at Devonport; and under his talented leadership I had the honour of observing several expedients resorted to by that officer to train the eyes of the seamen gunners by aiming at moving objects both at anchor and under weigh, both in dumb practice and when firing shot; therefore this special subject of eye-training came before me, as an instructing lieutenant, very prominently. I think it is one to which now, in these days, the greatest importance ought to be attached, far more than in the days of smooth-bore guns, because our guns are reduced very greatly in number, and therefore it is even more essential that a larger proportion of the shot fired, should hit the object aimed at. Rifled guns also require far greater delicacy of aim, as their shot do not ricochet straight, and our chances of hitting are limited to direct fire. Fewer eyes directing a broadside demands higher training. Captain Poore's invention supplies a great want, one felt by every gunnery instructor, because of the difficulty we have in dumb practice at sea and in open roadsteads, both in getting any object on which to align the sights, and in observing when the trigger-line is pulled, whether the sights have been truly aligned before the roll carried them out of line with the object. This is essentially a sea target, to be used at all times whenever a gun is cast loose. Provided with such an implement, the instructors could do on board ships at sea with reference to the great guns, that which is invariably done on shore with reference to small arms. With small arms men are never allowed to bring the piece up to the shoulder without aligning the sights upon some object. So in heavy-gun-drill, the trigger-line should never be pulled without an Officer looking over the shoulder of the Captain of the gun to see if the levelling be accurately done. I may remind those who have not had the advantage of seeing the different plans that were formerly in use afloat (which I am sorry to say are not to be found at present at some of our gunnery establishments), that there are a variety of plans which have been employed, and successfully employed, in order to train the gun's crew to follow rapidly the motions of their Captain's hand and eye by aiming at moving objects, and thus training simultaneously the hands and the eyes of the men without using powder and shot. When your lordship commanded the "Wellesley," you will remember that you had a line stretched outside the ship with knots upon it opposite the centres of the ports, and by drawing that line quietly along a few inches at one end of the ship the whole battery of guns were set in motion following with their sights the miniature targets on the rope. Your Lordship had also a means by which the rope

with its knots could be raised and lowered, so that the instructor could vary the elevation as well as the direction. Your Lordship may remember the superiority of the subsequent firing at Kurrachee from the guns of the "Wellesley," showing that your Lordship's care was well rewarded. Your former Gunnery Lieutenant, Admiral Jerningham, when commanding the "Cambridge," invented and introduced a small line target for single ports, by which the seamen could be trained to work their guns and aim their sights without any word of command from the instructor. The line was drawn across the port and raised by pulling its end, and it was drawn back and lowered by the india-rubber accumulator springs. Besides that, Admiral Jerningham introduced the habit of making a boat pass slowly along the broadside, and whilst the battery engaged in independent firing at the water-line of the boat, at varying heights of sight, each captain of a gun had behind him a warranted gunner looking over his shoulder to see whether the sights were correctly aligned to the water-line of the boat. That was one of the most valuable eye-practices we had. A chart of ascertained distances of all the principal objects within sight, including the ships at anchor, was also prepared, and the Captains were required to judge their own distance and lay their guns accordingly, the instructing officer correcting the guess publicly. Whilst inspecting other ships, Admiral Jerningham made his galley or gun-boat pass slowly along their broadsides, according to prepared signals, whilst at general quarters. He also practised the men occasionally at firing with shot at targets towed astern of a gun-boat going at full speed. These practices kept the officers and instructors alive to the fact that the object of gunnery training is not gymnastics, but to strike moving objects with shot. Those plans, and all plans, for training the eye whilst working the gun in dumb exercise, appear to me to be thrown overboard at present: certainly it is so in the "Excellent." I quite agree with Captain Poore in his low estimate of the lever-target. It fails to train the hands of the crew simultaneously with the eye of their Captain. These two objects should be simultaneously effected. No gunnery lieutenant ever paid much attention to the lever-target. They handed it over to the gunner's mate to look after as part of the routine to be got through, but never thought it of sufficient value to occupy their own attention. Then, whilst speaking of the absence of plans for training the eye at dumb exercise both at anchor and at sea, I should like also to point out that the eye is not even trained with accuracy when seamen gunners fire powder and shot from gun-boats at Spithead. No means are taken when thus training future gunnery instructors by showing them how firing should be conducted under weigh, to ascertain the distance of the target or where the shot falls by observations taken at right angles to the range; so that these expensive shot are literally thrown into the sea, and nobody knows what part of the sea they fall into. An obsolete 40-pounder 35 cwt. breech-loader gun is about to be embarked for this inexact kind of uninstructive practice at Spithead—a gun that is not seen in any sea-going ship—and the future instructors of the fleet are to be trained up to this loose way of throwing away shot—men who ought to be taught the most accurate system of aiming and of ascertaining the correctness of their aim, in order that they might be competent to instruct the fleet how to conduct target practice at sea in the most accurate way possible.

The Chairman: As Captain Dawson has alluded to me, on this question of the artificial way of teaching men to fire, I can only say that I tried almost every possible plan, when I was in the Navy. First, there was the "lever-target," and then we had sights fixed, a musket barrel along the top of the gun, and various other plans. But, I came to the conclusion that there was nothing like real firing, let the shot be ever so small; but it must be powder and shot. The result was this:—I fixed a rifle on a stand, on the poop or in a boat, like a pivot-gun on a centre, one of those proper stands that we have that would not shake. There was a lanyard, the length of a common lanyard to a gun, and I always towed a small target, with a flag astern. The men were put to this, and they were allowed to fire as many shots, with ball cartridge, at it as they liked. The more the ship pitched and rolled, the more difficulty there was. When the men were put to this they, perhaps, would not hit with one shot in twenty, but, in a very short time, firing 40, 50, or 100 rounds a day, the men hardly ever missed the small target with the ship pitching so that you could hardly stand on your feet. That was the result. When I found the men—when the ship was pitching in this way—did not miss one in ten shots, then they were

allowed to go to a gun—a six-pounder—and, having fired the six-pounder put on the poop, in motion, then they were ready to go to a big gun. I am still of the same opinion, that all the practice you can possibly give men, with these large guns, will never teach a man to be a good shot, without some contrivance of the kind I have mentioned. It is given up entirely now, but I think that this plan is very likely to answer, and as Captain Scott has said this target of Captain Poore's has been tried, and found to answer.

Captain FIELD, R.N.: The reputation of the old "Excellent" is very dear to me, and I cannot allow my friend and old messmate here to sit down, and let his remarks go by without a reply. There is no Officer present, belonging to the establishment, to defend the "Excellent," and its system of training. Now, I have the very highest opinion of its system. I know it was a very good one during my period of service there, as an Instructor, many years ago, and I am not so foolish as to believe that it has since, in any way, declined. I believe that, with the present arms of precision, it is not so necessary to waste so much time on "lever-target" practice as was done formerly. Therefore, I think a good deal of the criticism that my friend has passed on the "Excellent," and, also, on her system of firing at Spithead, from gunboats which he finds fault with, is uncalled for. I think if the Officers present would receive those criticisms with a certain amount of misgiving, and would give the Officers of the establishment credit for being thoroughly up to their work, and throwing their whole heart into the work, they would arrive at an accurate conclusion.

Commander DAWSON: Is it a fact that, in training the future gunnery instructors of the fleet how to conduct target practice, by firing from a gunboat, at Spithead, the distance of the target is not ascertained? Is it a fact that, when future seamen gunners, the marksmen of the fleet, are firing shot at Spithead, there is no step taken to ascertain, at right angles to the range, where the shot falls? Is any eye-training adopted, at dumb exercise in the "Excellent," other than the old lever target?

Captain GOODENOUGH, R.N.: I have one suggestion to make. This instrument promises to be very useful. I think it would be found very likely, when the ship is rolling, that, with so long a length of pendulum as there is there, the weight would acquire a certain amount of proper motion, and I would suggest, whether carrying the weight up nearer the point of suspension would not reduce that proper motion, and make the movement of the target more closely resemble the movement of the ship.

Rear-Admiral HOUSTON STEWART: My lord, I can also speak to the small gun you had fitted on the poop, and over which you used to spend many hours every day, teaching and superintending the firing of a whole ship's company. Having been a youngster with you, I subsequently had the pleasure of introducing that same plan into every ship that I have had the honour of commanding since, and it was also introduced generally into the Mediterranean fleet. I believe you will find your own original plan is still adopted and used in many of our ships.

Lieutenant FERRIS, R.N.: I should like to say one word for the "Cambridge." The system of eye-training, on board that ship, is most perfect. Every Friday, at first quarters, a boat passes slowly along each side. There is a gunner at each gun, and the captain to supervise the pointing of the gun, and under Captain Herbert's and Lieutenant Jackson's able supervision, she trains her seamen gunners, in that part of the world, in a most efficient manner.

Captain POORE: I have to thank Captain Goodenough for his suggestion. Perhaps this pendulum, being so long, it does give rather more motion than a ship would actually possess. But I do not think that is altogether a disadvantage, because, when there is very little motion in the ship, it gives the target more motion, and would train the men to fire at a more difficult object.

The CHAIRMAN: You are aware that a pendulum on board a ship, is comparatively useless; it gets a motion beyond that of the ship. In a ship under sail, there is a sort of jerk which sends the pendulum over many degrees more than the heel of the ship. I think you will allow me to thank Captain Poore for his paper. We all know it is a very important point, both on land and sea, to be able to shoot with accuracy. In fact, without accuracy, these monster guns that we have got now, are comparatively useless, for we have so few of them.

Evening Meeting.

Wednesday, March 26th, 1873.

Admiral the Right Honourable the EARL OF LAUDERDALE, K.C.B., in the Chair.

NAMES of MEMBERS who joined the Institution between the 4th and 26th March, 1873.

LIFE.

Graham, William, Captain R.N.
Rosebery, Earl of, Dep.-Lieut. of Linlithgow.
Hoskins, A. H., Captain R.N.
Harcourt, E. W., Colonel Cinque Ports Artillery.
Glen, Archd., Lieut., 10th Regiment.
St. John, O. B. C., Captain R.E.
Lansdowne, Marquis of, Under Secretary of State for War.
Foley, Hon. Fitzalan, C. J., Lieut. 2nd Derby Militia.

ANNUAL.

Dugdale, Arthur G., Lieut. R.A.
Browne, H. D., Lieut. 60th Rifles.
Brooshooft, E. A. D., Lt.-Col. 4th East York Art. Volunteers.
Holroyde, J. B., Captain 8th West York Art. Volunteers.
Crossley, Lewis J., Lieut. 8th West York Art. Volunteers.
Evans, H. D., Captain R.A.
Elliott, William, Captain 4th East York Art. Volunteers.
Murray, J. J., Colonel Bengal Staff Corps.
Aytown, Andrew, Lt.-Colonel, h.p., R.A.
Lyttelton, Hon. C. G., Lieut. Worcester Yeo., M.P.
Lightfoot, J.G., Colonel late Bom. Artillery.
Manderson, G. R., Major R.H. Artillery.
Anstruther, Alex. W., Lieut, R.A.
Mackinnon, G. H., C.B., Lt.-General.
Jervis, Hon. J. E. L., Lieut. 7th Hussars.
Spencer, R. H., Lieut. 2nd Dragoon Guards.
Barrow, P. H. S., Lieut. 19th Hussars.
Bomford, S., Major Gloucester Militia.
Crealook, H. Hope, C.B., Colonel Unatt.
Henderson, J. W. Cleland, Captain Madras Staff Corps.
Howell, Thomas, Esq., Director of Contracts, War Office.
Aislabie, R., Major R.A.
Pemberton, R. C. B., Major R.E.
Brownjohn, Wm. W., Lieut. 57th Regiment.
Robertson, R. S., Captain Bengal Staff Corps.
Boyd, A. R. A., Captain 25th Lanark Rifle Volunteers.
Duff, E. Alex., Captain Queen's Own L.I. Militia.
Stewart, Hon. Alexander, Captain R.H. Artillery.
Coventry, H. A. F. F., Lieut. 60th Rifles.
Toole, John, Quartermaster 60th Rifles.
Sewell, John H., sub-Lieut. 20th Hussars.
Hall, Henry. Lieut. 19th Hussars.
Cowan, Phineas, Major 3rd London Rifle Volunteers.
Hale, Robert, Lt.-Colonel 7th Hussars.
Cadell, A. T., Colonel R.H. Artillery.

Discussion on the points raised by Mr. Barnaby, Chief Naval Architect, Admiralty, in the paper read by him, entitled, "Lessons from the

"'Hotspur'-'Glatton' Experiment," and read on Monday evening, March 3rd, 1873.

Points for Discussion.

1st. Is armour retained in ships of war to protect the gunners or to protect the ship?

2nd. If for both purposes, in what proportion should it be distributed? Should the armour in front of the guns be one-fourth thicker than that protecting hull, boilers, and magazines, as it was in the "Captain"?

3rd. Or, remembering that men are of no use in an action without a ship to fight in, but that a ship may remain an efficient engine of war with neither guns nor gunners—remembering this—ought we to keep the hull afloat at all hazards to life and limb from shot and shell"?

4th. If we stint the armour on the hull in order that we may thicken that upon the battery, will not a wise enemy, if he happens to have guns enough, fire broadsides into the hull-armour in order to endeavour to reach the machinery or magazines, and fire, at the same time, with light guns at the gun-ports.

5th. If you decide that the hull must have the preference, and should have thicker armour and surer defence than the guns and gunners, it may be that you would go so far as to say that, in an extreme case, where the weights were strictly limited, you would even leave the guns without armour, in order that the hull may be made secure.

6th. The abandonment of armour protection for the guns leads at once to an increase in the power of the artillery, because the increase in the number of guns, presents but little difficulty as to weights, if they do not require to be armoured. Do you then consider that when we have a ship which has been so armoured as to be practically unsinkable; by shot, in which the boilers and magazines have been made secure, and in which the number and power of the guns have been so increased, that a concentrated broadside may mean six or seven 18-ton guns—all directed at the same spot, and fired by wire at the same moment—do you consider that such a ship would stand a fair chance in fighting with an enemy with penetrable hull-plating and few guns, but those guns protected by armour?

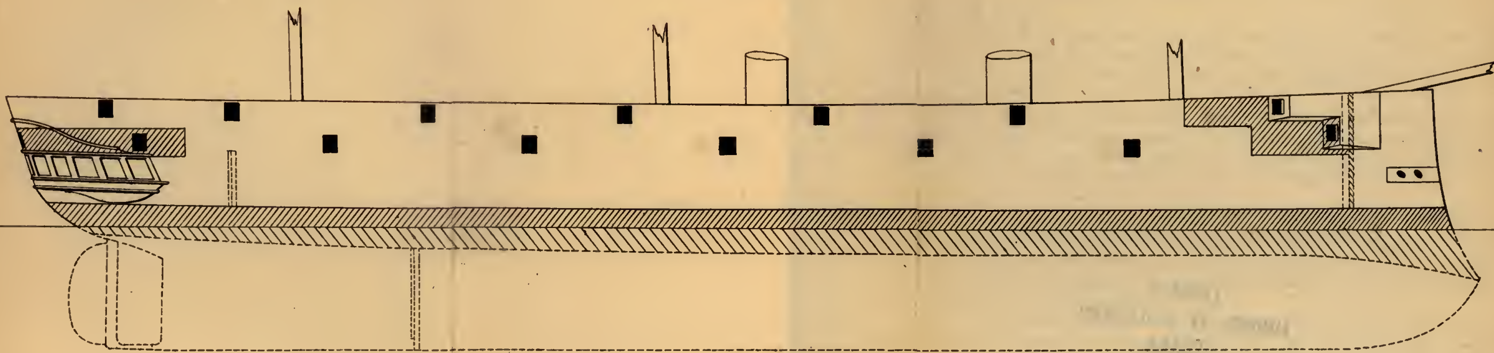
7th. If you think she would, let me add, an armoured traverse at each end of the gun-deck, with ports in it for right ahead and right astern fire, and let me add also an upper deck armament of light guns to fire at the ports of the enemy, and she will probably commend herself still more to your judgment.

Chairman: Gentlemen, before we begin the discussion, I think it right to say that we are here to-night solely for the purpose of discussing the points that Mr. Barnaby put before us at our last meeting. I hope, therefore, that all the speakers will keep to these points, and not fly off upon gunnery questions, otherwise we shall not get through the business of the evening.

Mr. Barnaby: My Lord, Ladies, and Gentlemen, in accepting the invitation to come here to-night for a discussion of the points which I laid before you the other evening, I said that I should like to say a few words before the discussion opened. I think these few words are due to those who heard my paper, because I have been

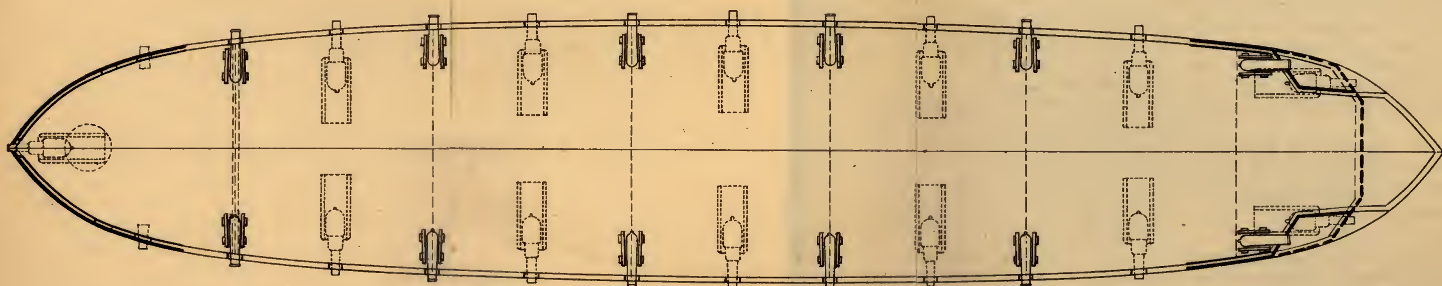
IRON-CLAD SHIP WITH OPEN BATTERY.

ELEVATION.



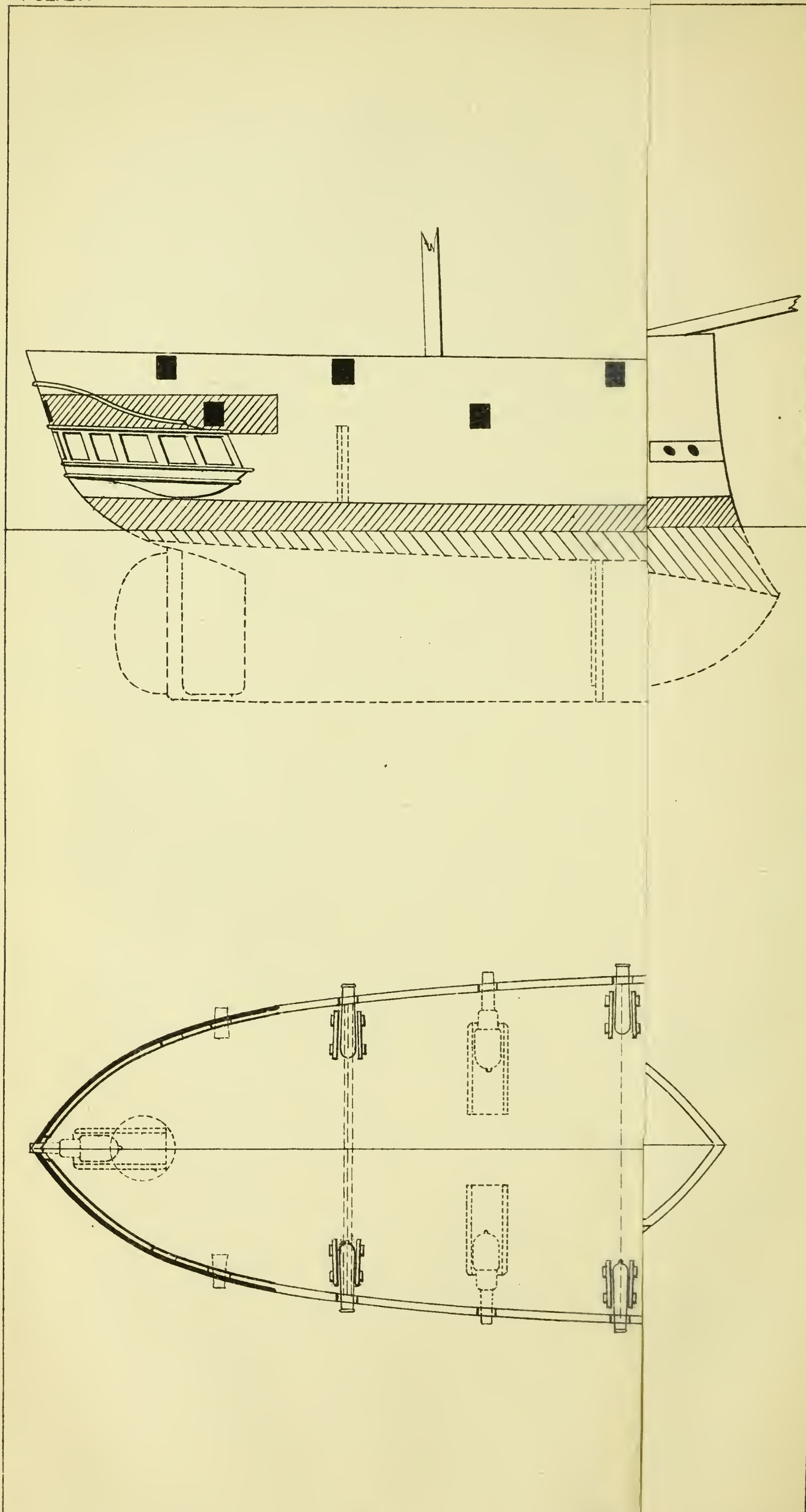
PLAN OF UPPER AND MAIN DECKS.

The dotted lines represent the Guns and Bulkheads on the Main Deck.



N. B. The shaded parts represent Armour

J. Jobbins



J. Jobbins

told that I did not make it clear that the drawing of the ship then shown, did not represent the ship which is pointed to in the questions referred to this Institution for discussion. I did not then state anything more about the ship than this, that she illustrated the "barbette-battery." I may say now that those two drawings represented the "Téméraire," *see* Plate XV, which is to be built at Chatham. She is, as will be seen, and as I pointed out when I described her before, different from any ship which has been built in England up to this time in respect to these upper deck batteries, and if you will allow me I will just make clear what the ship "Téméraire" really is. She is then a ship of 14 knots speed. She has 11-inch armour for the protection of the hull, and 2-inch plating on the deck. She has two batteries on her main deck, one lying immediately before the other. Those batteries are so arranged that the guns in the foremost one, which are 25-ton guns, proposed for the first time to be broadside guns, fire right ahead. This battery abaft, cut off from it by a traverse of armour, contains four 18-ton guns, which do not fire either ahead or astern. She therefore has a main deck battery of three guns on a broadside, one being of 25 tons and two of 18-tons. On the upper deck, instead of there being a central battery, as in the "Sultan" the "Swiftsure," the "Triumph," and other ships, these two armoured "barbette-batteries" are introduced, one containing a 25-ton and the other an 18-ton gun. The foremost one answers the purpose of a conning house as well as a battery; it is protected by 10 inches of armour; the after one, by 8 inches of armour. The ship thus has three 25-ton guns ahead, one 18-ton gun astern, firing all round the stern, intercepted only by the rigging of the mainmast; the foremost one firing all round the bow, intercepted only by the rigging of the foremast, and she will have a broadside of two 25-ton guns and three 18-ton guns. The main battery is protected by 8 inches of armour all round, and the inner traverse has 4 inches of armour; this after battery is therefore protected by 12 inches of armour.

This ship (PlateXVI) may be regarded as a sort of compromise. She has more powerful fire than she would have had if some armour for the defence of the guns had not been surrendered. Some armour for the defence of the guns has been given up; the guns fight on the upper deck in the open. The question to-night is, as you will see from the paper, "to what extent should armour be retained for the protection of guns"? The ship which is intended to illustrate the questions put by me the last time I was here, is shown by these diagrams. This is a ship of the same size as the "Téméraire," but she has what may be called an open battery. The hull of the ship is protected in the same way in both ships, but there is no armour for the protection of the guns except at the bow and stern. There is a traverse of armour across the bow behind which those two guns fight, and which protects from a raking fire, the whole battery. There is a traverse of armour also across the stern, protecting one gun, and protecting from a raking fire, the stern of the battery. The battery therefore would consist of seven broadside 18-ton guns for concentrated fire, and a battery of twelve light guns on the upper deck, 64-pounders. That is the ship which is indicated there.

There are several forms which the "open-battery" ship may take. You may have a ship with the same protection to the hull, as in this case, but with 300 or 400 tons of armour removed from the ship as compared with the ship with all her guns protected by armour, and that 330 tons thrown into guns and ammunition. Another way in which the question may be viewed is, that, supposing the guns are not protected, the hull-armour may be by so much increased. For example, there are existing ships in which we have about 700 tons of armour to protect the hull, and 1,200 tons of armour to protect the guns. That is another way in which the question may be put. I am just mentioning these things in order to direct as far as I can the discussion on the seven questions.

It is necessary that I should say another word as to the history of this design. That design was discussed when consideration was given to the designs for the "Téméraire." It is an abandoned design, which was discussed in the autumn of last year. The reason I mention it is that, curiously enough, at the very moment that we were discussing the plan, they were discussing in France, the very same thing without our knowing it. I have here a brief extract from a very interesting article which has been published in the February number of the "Revue Maritime," by Vice-Admiral Touchat, who occupies a position in France corresponding to that of the Controller of the Navy here, and with your permission I will read a few

extracts from that, freely translated, and with certain omissions. Referring to the "Gloire," "Marengo," "Hercules," and "Kœnig Wilhelm," he says:—"These, "then, are the instruments for fleet-fighting of to-day. Is it to be believed that "they will continue to occupy the first position, that they will be the *ne plus ultra?* "No, for the gun goes on always increasing in power; and in France, as in England, "Russia, and Prussia, we are no longer contented with guns of 10 and 11 inches, "we go up to 12 and 13 inches, and there are laid down in the dockyards, ships for "fleet-fighting, plated with armour from 9½ to 12 inches thick, and from 9,000 to "10,000 tons displacement. Where shall we stop in this strife? Where will it "end? I see the end" (he goes on to say) "in the abandonment of armour for the "guns. Sooner or later this will be the end for the "navire d'escadre," or, as we should call it, the armoured cruising ship. "Let us admit if you will," he says, "that the battery should for the future be plated with armour of 10 inches, as it "soon will be, the question of abandoning it will nevertheless be resumed upon these "two considerations:—1. Is battery armour of 10 inches penetrable? 2. If it is "penetrable, does it not become rather a danger than a protection?" And then he goes on to say:—"And now let us see what will take place in a battle between fleets. "The two squadrons being in order of battle, if both freely accept the contest, there "will be collision by ramming, either with or without preliminaries. In any case "it will suffice that one of the two should be resolved for it to make ramming the "first act; let us mark the opening phase of the fight. The combatants advancing "towards each other would be ranged in one line, or in several, or in squadrons; "but, whatever be the order of battle, there will be formidable collisions and grind- "ing of the sides; they will cross each other's course, and then, putting the tiller "hard over, will return to the encounter. Again will they strike and again pass on. "Woe to the vessel which, disabled by the first attack, or turning less quickly than "her adversary, exposes her flank! Like the 'Ré d'Italia' at Lissa, she will be "sunk by a single blow.

"It is here—in this initial phase—the ships perpetually fouling each other, that "the gun appears on the scene in all its might. The manœuvre is foreseen. A "single order, clear, concise, energetic, follows in three words, 'prepare for ram- "'ming.' At this command, the guns are pointed low; the captain of each, his eye "fixed on the sights, with bent body and extended arm, waits! He watches the "moment when his adversary will pass before the muzzle of his gun—the moment, "fleeting as the light which he must size for firing. Silent and motionless each "man is at his post, but lying full length upon the deck. The Captain alone remains "erect; suddenly the guns and musketry burst forth, and the vessels crash into each "other with their sharp-pointed prows, and gliding by each other prolong the con- "tact along their sides until they reach their sterns, which they avoid in order to "protect their rudders and screws. After this first encounter, the combat will always "be carried on at a short distance, if not broadside to broadside, the gun and "rapidity of evolution playing the principal *rôle*.

"In this strife of vessels, let us take two opponents. The first is an armour- "plated cruiser, with 9½ plates on the battery, which will soon relegate the actual "vessel to the second rank;"—9½-inch plates on the battery is the thickness which "has actually been adopted for the most recent design of the French Government;— "it is armed with 12″ or 12½″ guns, carried in two divisions, *i.e.*, two or three on "each side. This is a small quantity, but the more the weight and calibre are "increased the more the number is diminished; thus it is that the 120 guns of "our old three-deckers are represented—I might almost say combined—in the "armour-clad cruiser by 8 or 10 guns. Now with regard to the military value of a "gun, its efficacy does not wholly consist in the size of its bore; of what importance "is a large shot if it does not attain its destination? In the vessel of 120 guns the "loss of a single badly-directed shot is comparatively nothing; in armour-plated "ships the loss of a single shot of the eight or ten which I can fire is a great deal. "For each of these great guns ample fighting-room is necessary in order that it "may be freely and rapidly manœuvred; above all, it is necessary that the gunner "—the soul of the gun—in the midst of these evolutions, these tournaments of war- "fare, should always see the object of his aim, always follow it with his eye, to strike

" it at the favourable moment. Is this possible through the narrow frame of a port-" hole full of smoke and quite filled by the muzzle of the gun?

" But this is not all. This central fort, with its side armoured with plates " $9\frac{1}{2}''$ thick, is not impenetrable in all the phases of this fight, and at all the " distances. It can be pierced by the enemy's shot, and without doubt such will " be the case. Imagine what effect will be produced by one of these projectiles " penetrating the central fort, there bursting and projecting before it a murderous " cone of fragments of wood and iron. The space is confined, the guns are disposed " in two lines, starboard and port; the men are crowded. Everything will be cut " down, overthrown, destroyed, not a man will remain erect, not a gun in a fit state " for firing. 'All will be over,' was said to me by one of our officers, who during " the war commanded one of our most powerful armour-clads.

" Of what service, then, is this cuirass from the moment when it is penetrable. " Far from being a protection, it is a danger, and it only interferes with the fire of " those guns which it is powerless to protect.

" Of the two adversaries whom I have considered the second is unarmoured." Admiral Touchat's view, in what follows, is not at all the view I have taken. " It " has the same number of guns as the first and of the same calibre, but, instead of " being concentrated in two lines in a battery, these guns are disposed '*en barbette*,' " on a carriage with a central pivot, occupying a single line amidships in the fore-" and-aft plane of the ship," an impracticable arrangement, as I venture to think. " There they are, in the open, in full sight, commanding the whole horizon. The " advantages of this arrangement, viewed with regard to efficiency, are very striking. " In lieu of the training space, limited and almost annulled by the narrowness of " the ports and the size of the guns, there is substituted for each piece a training " space extending from side to side, while the glance of the gunner in full possession " of the horizon, ranges freely and uninterruptedly over the object to be attacked. " There is another view in that inevitable phase of the combat in squadron which " for an instant—and that a decisive one—places the combatants side by side, she " brings the whole of her pieces into play, whilst the ship with a battery can only " oppose a half. Thus it is that, to the broadside of three guns from the battery, " the ship without it can oppose six guns of the same calibre.

" Thus in the double light of the number and proper direction of the shot, of " their efficiency, the advantage belongs to the second vessel, to that whose artillery " is not cuirassed. But this is not all. By suppressing the plated battery a great " economy of weight is accomplished, and this economy if entirely applied to dis-" placement permits a diminution in the length of the vessel, to the great profit of " its powers of evolution, so that, other things being equal—that is, with the same " speed, the same handiness in manœuvring, the same sail power and armament— " the one ship will turn quicker in a smaller circle; now, to turn quickly in a small " circle is the *cardinal* faculty in an engagement with prows.

" Thus, in conclusion, the vessel without an armoured battery will cost less, be " more handy, more capable of evolution, and its offensive power, considered with " respect both to the gun and the prow, will be notably increased.

" I stop here. After having put two adverse squadrons face to face. I have " detached two vessels from the group of combatants, both equally protected at the " water-line, both armed with guns of the same calibre and equal in number. In " the one case these guns are covered—I can no longer say protected—by an " armoured wall; in the other they are exposed, or merely masked by a movable " screen of steel plates which protects the gunners from musketry. These ships I " have opposed to each other, and by bringing before the eyes of the reader succes-" sive phases of the combat, I have endeavoured to show that the advantage should " belong to that whose guns are unprotected, it being thoroughly understood that " I only speak of *lateral* protection. The principle of a combat 'end-on'—that is " to say, by ramming—being admitted as a consequence of the spur, and as the base " of naval tactics, the *longitudinal* protection deduces itself; this is obtained by " means of an armour-plated transverse bulkhead placed forward, or by some other " analogous disposition. As it is not my object to define the means, I confine " myself to simple indication."

" It should thoroughly be borne in view that I have taken care to define the

"nature of this inquiry; I repeat it is only a question with regard to cruisers as to "the amount of protection and of the artillery they may carry. Were it a question "of coast defence vessels it would be quite another thing. The coast defence ship "may pretend to invulnerability (long though the word is, it may well be employed "to express the thing)—it can pretend to it especially on account of its form. The "cruising ship cannot pretend to it; at the most it will only obtain a *relative* "invulnerability, that is to say, dependent on the distance of the combatants and "the direction of the shots. But in a fight between cruisers, as I understand it, "the distance will in no case exceed what I have termed '*fighting distance*,' from "1,000 to 1,300 yards, and in that initial phase, which I have called the *decisive* "phase, the greater part of the blows will strike square to the surface. If, then, "anyone claims for the cruiser relative invulnerability, I may be allowed to refuse "him the benefit of it.

"If it be true, on the other side, that as against the cruiser as it at present exists, "either afloat or building, the gun has definitely asserted its superiority, there are "only two possible solutions of the fighting ship, the mastless ironclad, such as "the 'Devastation,' or the Russian monitor, 'Peter the Great,' and ships masted "but without protection for the artillery. These two types combined—armoured "ships without masts, masted ships without armour, mutually aiding and assisting "each other will form probably the fleets of the future, but that which from the "present time can no longer be doubtful, is that the masted armour plated ship of "war, will no longer figure there."

As a comment before sitting down on that paper, which has just appeared, I may say that it is understood that the newest design of the French Government produced under this gentleman's auspices, has eight armour-piercing guns only,—she is the same size as the "Superb," viz., of 9,000 tons displacement. Four of those guns are left to fight in the open without armour. For the protection of the other four, the weight of armour taken would increase the weight of the armour required for the protection of the hull by 50 per cent. For the protection of four guns out of the eight, half the entire weight of hull protection has been taken, and the thickness of the armour protecting those guns from right ahead fire, is equal to the thickness of the armour for the protection of the hull. It is clear, therefore, that Admiral Touchard has no more been able to get rid of the armour in front of his guns than we have. Having placed the questions before you, I will now leave them to be discussed.

Rear-Admiral Sir JOHN HAY, Bart., M.P.: My Lord, Mr. Barnaby, and Gentlemen, I have come here this evening to obtain, as I always do when I come to this Institution, valuable information concerning the profession to which I formerly belonged; and I have come here to-night more especially because there is a discussion about to take place in the House of Commons on this very point. No doubt the matter before the House of Commons with regard to the ship that is about to be built,—I think the Controller is here,—has been delayed, not in consequence of this discussion, but because Mr. Goschen, the First Lord of the Admiralty, in the kindest manner, has sought for thorough information before he decides upon the class of ship which he is about to recommend that the country should build. I wish to give him every credit for the course he has taken. As Mr. Barnaby has well stated, ship-building now must be a compromise. There must be certain things given up, or portions of certain things given up, in order to obtain other things, or portions of other things, which are necessary for the conduct of our men of war.

The questions that have been propounded to-night, I shall endeavour not to reply to distinctly, but having a Scotchmam in the chair and being a Scotchman myself, I shall take the liberty of replying by sundry other questions with a view of eliciting further information, not only from the accomplished lecturer, but from the other accomplished ship-builders and naval officers who are present, and who are far more competent than I am, to speak upon this question. There are, as we know, very few ship-builders and very few naval officers in the House of Commons, and it is right that those who go there and speak upon a question of this sort should do so not in any party spirit, but with a view of getting the very best ship for the country, and when the Controller of the Navy, and the President of the Board are so kind as to invite discussion, and to ask for the best information on those points on which

we may agree or disagree with them, I think we ought to support them on just and fair grounds, not political, but of naval architecture and reason.

The seven questions before us all bear upon one point. I do not intend to traverse the ruling of our chairman; I am not going into any gun question or any question irrelevant to the seven questions which have been fairly propounded, and which are fair and proper objects for discussion. But I think there is a point which we ought all to recognise, and that is, first of all, what sort of ship do we want, as a man-of-war, be she large or small? What are the principal points we require, whether we be naval architects to build ships, naval officers to command ships, or tax-payers to pay for the ships, or the country to be defended, what is it we require for the class of vessels to carry the guns, and the seamen to fight our batteries?

The first qualification for a sea-going man-of-war is that she shall be seaworthy, and able to keep the sea. I think those are the first two points which we must admit to be necessary in all ships. Leaving entirely out of question any ship like the "Glatton," I am going to discuss a ship which shall have masts, and which, according to my view, having masts, will be a sea-going man-of-war, and I will confine myself to that. She shall be seaworthy, and able to keep the sea. What is seaworthiness? That is a point upon which I do not think we shall differ. Seaworthiness consists of adequate proportions, a just distribution of weights, and sound workmanship and material. The two first points are those points in which compromise is necessary—the question as to the adequate proportions and the just distribution of the weights. I do not go into the question of sound workmanship and material, because that is of course necessary. What does keeping the sea require? It requires a sufficient and healthy accommodation for the crew, sufficient space, and I wish to note this adjective—I do not know whether it is a right one—sufficient space and inexhaustible means for conducting the ship in safety on her various duties. I put that "inexhaustible," because coal is exhaustible; I am therefore putting it with sail power, and sufficient space for the armament and its exercise. I think that gives what a ship which must continually keep the sea requires, having already stated that she is to be seaworthy, and not to be dependent upon a coal tender, but to be capable of maintaining her position in all weathers, at all times, and under all circumstances.

The next quality, I think, a man-of-war requires is speed, and as the supreme effort will usually be made under steam, that is to say, when she is going to fight, or going into action, or when she is chasing, steam will be called into play, speed under steam should rather have the preference in her form. I do not say whether I prefer the screw, the paddle, or the hydraulic propeller; I am not going into that question at all, only the vessel should sail well and steer well under sail. But if to obtain a great speed under steam the sacrifice of a little speed under sail is necessary, I think it should be done, for the supreme effort to be made is when having saved her coal by her sailing power, it becomes necessary for her to fight her battle or chase her enemy; then her greatest power is called out, and her greatest speed will be under steam.

There are two or three other things which are partly in the nature of compromise, but are very valuable in men-of-war, and one of these is "light-draught," so as to be able to go in and out of harbours in all parts of the world at all times. There is the well known and constant Suez Canal, which of course gives England additional power in her Eastern and Western possessions. There is the St. Lawrence, and there are a number of other places where light draught is of the greatest possible value, and where men-of-war may be required. Putting first the seaworthiness, ability to keep the sea, and speed, I then come to light draught. I suppose it is useless to clothe such a ship as that. No doubt, barring light-draught, you might get a seaworthy ship, a ship to keep the sea, and a ship of great speed, entirely clothed with impenetrable armour. If the rule which did obtain, holds good, that a ship of a thousand tons will carry an inch of armour, and, roughly, that for each additional inch of armour you require a thousand tons, when you come to the 16 inches which is now required to protect us against some of our guns, you naturally would require a ship of 16,000 tons before you arrive at a ship completely protected. Therefore I come to the conclusion at which Admiral Touchard has arrived, that it is impossible to conceive of any ship but a ship of the very first class, ships of which I do not think

many are likely to be constructed, which will be entirely and completely covered with impenetrable armour. If the armour is not impenetrable, then it is worse than useless. I had the honour,—as I dare say many distinguished Officers here present had,—of knowing an Officer whom all naval Officers must regret, I mean the late Admiral Tegethoff, one of the most distinguished Officers who ever commanded a fleet. Admiral Tegethoff, relating to me the events of the battle of Lissa, spoke of the "Affondatore," and defended his antagonist, who, unfortunately for him, Admiral Persano, had hoisted his flag therein. Admiral Tegethoff pointed out that he himself, having his flag in a ship very partially protected, and not at all protected in the upper works, had the singular advantage of having a ship which was so handy that she rammed and destroyed the "Palestro" and the "Ré d'Italia," and that in doing so he lost very few men; whereas the "Affondatore," being totally unmanageable, was unable to do any of the service which no doubt her Admiral desired she should do. She was invulnerable no doubt, but she was helpless from being overweighted; and Admiral Tegethoff pointed out that in some of the ships of his squadron, which were partially armoured, the shell were just detained long enough in passing through the armour, to burst where they were wanted to burst, whereas in the ships which were not armoured, they went right through, and burst a long way off, where they did no damage. We are now coming to shell, which, unfortunately, may be detained a very short time and will do an enormous amount of destruction should they burst, if they are detained long enough to burst in passing through a ship.

But we have also to guard against the ram and the torpedo—the manageable torpedo. We have information of torpedos that are manageable no doubt, used in the American war, but they have been recently only re-invented in a manner which can be applicable to sea-going ships in deep water. We have now the ram and torpedo to defend ourselves against, and I confess I believe the wound from a ram or a torpedo will be far more serious than the wound from any shot or shell. If that be so, what part of the ship is it best to protect? Where will the wounds be inflicted that are most dangerous—not the wounds alone from shot or shell, but the wounds which will also be inflicted by the ram or torpedo? If one considers that, I think it would be admitted that the great danger is not the danger of having your men killed, nor is it the great danger of having that which was considered also, having your men demoralized by very great slaughter in the batteries. The slaughter in the batteries will be nothing to the danger of being sunk or blown up. I conceive therefore the first thing to protect is, the magazine. I do not speak externally. I mean to say that the magazine in these days should be entirely, and perfectly, and thoroughly protected, so that there should be, as far as possible, no danger from any external missile. Next to that, as I have already said, in this masted ship, the ship which is able to keep the sea, but which requires that her machinery shall be available for taking her into action, the next thing is, as far as possible, to protect that portion of the engine-room in which that motive power is contained.

After that, and many persons would put it first, and I am not quite sure whether I should not put it first myself, but I put it third, is the "steering-apparatus." I put it third, because the rudder is so difficult to protect in itself, that the rest of the steering apparatus, the rudder being destroyed, is of no use, and therefore I would not devote so much to protecting the wheel and tiller as I would to protecting the magazine and machinery. And I say that, too, with the hankering desire which I admit, after the hydraulic propeller. But I won't go into that now. I merely say that, because I think by means of a hydraulic propeller you are able to steer the ship even if the rudder is damaged. That is a controverted point, but I allude to it, and I say that the steering apparatus, perhaps, should go first, were it not that I have in my inner consciousness a belief that there is a power, which Mr. Dudgeon and others possess, which might assist us in protecting the steering apparatus.

After that I come to the machinery of the gun. I am not going to discuss the turntable, or going into any other question, but all our heavy guns require very delicate machinery—I mean delicate in this sense, that they are liable to destruction by shot and shell. As far as the lower portion of the gun-carriage can be protected, I think it should be protected. I have not yet convinced myself whether the

barbette tower system is the best, but I do confess, to maintaining the magazine, the steering apparatus, and the engine-room of the ship thoroughly, as I ventured to suggest; after that the fighting portion of the ship, that is to say, the means of training the gun and working the gun, leaving the gun and its men to take care of themselves; but that is the next thing to which you should devote complete protection. In all these points I may speak of the application,—as far as may be possible,—of very thick armour, as thick as the ship can carry, for the particular purpose of protecting the portions in detail which I have mentioned (in the small ship in which you cannot afford a fraction of armour to protect anything but the magazine, I would have the magazine thoroughly protected): each protected by itself, entirely and completely, in the order in which I have ventured to suggest.

Well after that comes the water-line,—I mean that portion of the ship which is likely to be injured by the ram or by the floating torpedo—that portion of the ship in which she may be hulled between wind and water by shot or shell—it would depend in certain ships as to whether it was a band of 4 feet, 6 feet, or whatever it might be, but it would be in proportion to the distance the ship was likely to roll and was likely to expose her side in action, and also to what was likely to be effected by the various considerations that I have ventured to allude to. There I would give the next protection.

After that I would try to protect the men, though I do not think there would be anything left to protect them with; and after that in the 16,000 ton ship, when Mr. Barnaby is so kind as to build her, and Parliament votes the money for it, then I would protect the whole ship and not till then. Now I have ventured to state as shortly as possible my questions in reply to the seven questions, and I hope I have not gone beyond the limits of fair discussion, and that I have endeavoured to put forward my views in no arbitrary manner. They are the views, that, unless I am better informed by the discussion of to-night, I should have expressed if these questions were put to me in the House of Commons, and, I have come here because I wish to find out where I am wrong and to be corrected. I am not at all sure that I have put forward views which will be acceded to by my brother officers or by shipbuilders present; but I thought it was not fair when so excellent an opportunity was afforded me, for gathering so much information, to allow it to pass. I only desire in conclusion to thank Mr. Barnaby for raising this discussion, and you, my Lord, for taking the chair on this occasion.

The CHAIRMAN: Before you sit down, Sir John, I think we are to understand from you that with regard to the first question put, "Is armour retained in ships of war to protect the gunners, or to protect the ship?" that your principle is first to keep the ship afloat, and, afterwards, to protect the guns as well as you can?

Sir JOHN HAY: That is the purport of my observations.

Mr. JOHN DUDGEON: As Sir John Hay has kindly named me in the course of his remarks, I feel bound to say something on this subject, and as Sir John has said that your Lordship and he were Scotchmen, and I also am a Scotchman, I may not, perhaps, be taking too much on myself. I do not speak on this subject as holding the same views or with the same sense very likely as the man who has to fight the vessel; or the designer of the vessel. My impression is that we are very much inclined to over-estimate the difficulties in this matter—that we are very much inclined to imagine that a difficulty exists when it does not really exist. Taking the guidance of my friend, Mr. Barnaby, he being a constructor, and I only a builder, and taking the opinions of my friend, Sir John Hay, as those of man who is going to fight the vessel, I must say I really do not see where any of these difficulties are. If I were asked to build a vessel to carry so many tons of weight in the shape of armour, so many tons weight in the shape of guns, &c., and I were asked to put that material in such a position as to be of the greatest possible advantage, I as a constructor would say—I would give him as much as he could possibly have—and I cannot conceive or I cannot understand for one moment why any difficulty should be raised when there really is none existing. What we have to do is this. We have to move heavy weights, such as our modern guns are, and we have to turn them round very quickly. Any man who has passed through the ordeal of partridge shooting knows perfectly well that there is only one method, namely that of making a pivot of yourself, and no matter whether he is shooting a

partridge or whether he is going to shoot a big ship, he has simply to do the same thing. The process is precisely the same in both cases. There is no other process that can be devised by Mr. Barnaby, by myself, or by any other man who is engaged in the gigantic business of ship-building, save that of placing your gun on a turntable and the only turntable that you can have, is that of the ordinary "Monitor." There is no method by which you can make a broad-side ship by any means that you can possibly devise, where you can get the same weight of ordnance as you can get in the ordinary monitor, such as those Mr. Barnaby has designed. As a constructor I must take leave to be at issue with what I gather to be the general opinion, namely, that it will be possible to build a ship in which men will fight as well without being protected by armour-plating, as they will do when they are protected by armour-plating. No matter what thickness the armour-plating may be, if I am fighting behind armour-plating, then I feel a sense of protection. With reference to the remark about the shells coming through, I must say I have great doubts about that, and I believe that the whole position assumed with regarad to *not* protecting the guns is entirely wrong. I believe that there must be a compromise between the two, and that is this: We will give the best bottom to a monitor, that possibly can be given, and I am equally sure that we can carry all the canvas that might be required to enable her to be a sailing cruiser, and that we can give her all the steam-power that may be required to make her the fastest ship on the sea. I do not think that there are any really practicable difficulties in the way. I am perfectly sure that our friend, Mr. Barnaby, could turn out something to meet those requirements, but I can assure him of one thing which neither he nor any one living will ever do and that is—turn out an unprotected ship to fight a protected one.

Mr. Baillie: With regard to the protection of the guns and gunners, which is a very important matter, and one of the questions raised by Sir John Hay, I would ask whether that could not be obtained by applying the Moncrieff system? It seems to me that if you were to work the gun on the hydro-pneumatic system, you would certainly gain complete protection to your guns and also to your men, because they would be down below. I would ask also, whether a better distribution of weights might not be obtained by that system? Because that is also an important question.

Chairman: I suppose you mean, if the guns were mounted upon Major Moncrieff's system the same armour that protected the ship afloat would also protect the gun when it was lowered down.

Mr. Baillie: Certainly, my Lord. And also with regard to the distribution of weights. As a sea-going cruiser, she would carry her guns, which are important weights, lower and better than she would if she always had them on the top of the upper deck or in a turret.

Captain Colomb, R.N.: There are some points to which I did not address myself on the last occasion, and which I should like to mention now. When Mr. Barnaby read his paper, I expressed a general and strong concurrence with his main views, and I must repeat that concurrence now, but on reading over more closely the questions that he puts to us, I am not quite sure that I agree with him in all the details. But, sir, there is one thought which always comes to my mind during the discussions which I listen to in this theatre on the questions of "armour versus guns," and of the general method of building the war ship of the future, and that is, what an immense quantity of opinion we hear expressed, and how very little fact is adduced to back that opinion. I gather one lesson from all the discussions, and that is—we want experiment, and I am perfectly satisfied that until we will consent to spend money, time, and trouble on experiment, we shall never get to the bottom of the question we are discussing to-night.

Chairman: Do you allude to Government or to private individuals?

Captain Colomb: I allude to the general fact, that it is impossible to decide a question of this kind on opinion; that you must have more experiment before you can decide what is right and what is wrong. I have been greatly struck with the translation of the paper by Admiral Touchard which the lecturer has read to us. I had read previous papers of his, but up to the present time I had not seen that particular paper, read to-night. There, I think, we saw expressed in the strongest way the want of fact and the bold expression of opinion which we see universally in

the discussion of these questions. I found great difficulty in drawing any lesson whatever from Admiral Touchard's remarks. I found him describing a ship going to ram, with, so far as I could make out, her guns manned, with a clear intention or giving a broadside in some way *previous* to ramming. If any member of this Institution will think that out, and try to ascertain how, previous to ramming, you can deliver the broadside to the ship you are going to ram, I think he will discover, and agree with me, that such a thing is not possible.

When we come to the distribution of armour, we have the first question put to us, "Is armour retained in ships of war to protect the gunners or to protect the ship?" and I think that the Navy generally would say, as Sir John Hay has said, "protect the ship first," and "protect the gunners afterwards." But I am not quite sure that it is certain that we cannot protect the ship with a less quantity of armour. We have been told by Sir John Hay, very properly, that we have to protect the ship not only against artillery, but against torpedoes and against ramming. Now it has often been put forward that there may be the proper protection for the hull, not in thick armour, but in a cellular system. We had a very excellent illustration of the value of the cellular system from Mr. Barnaby at our last meeting, where he showed us the accident that happened to the "Northumberland," and how complete her cellular protection was. But passing on from that—if we are to say that we can only protect the hull by armour, then the reply of the Navy universally would be, "protect the ship, and after that protect the guns and gunners." But I think that there is a general feeling in the Navy that the assumed answer to the second question Mr. Barnaby puts is the right one; he says, "*if for both purposes*," and I think the Navy generally believe that we ought to apply armour to both purposes. Sir John Hay made use of a very strong expression, in which I am sorry to say I do not quite agree with him. He said, armour was worse than useless unless it was a complete protection. Now that is a dictum that I demur to. I have always looked at it in this way—that the value of armour is simply this—"*to compel your adversary to fire so many fewer shots at you in any given time*," and I am satisfied that every inch of armour you put on the ship, effects that purpose. You compel him to carry heavier guns, and by compelling him to carry heavier guns, you compel him to fire fewer shots per minute, and therefore I look upon even a small amount of armour as a very valuable thing. It has been rather put to us to-night that there is a possibility, and Admiral Touchard seems to express it very strongly, that an unarmoured ship, with very great gun power, might successfully meet in the open sea an armoured ship. Mr. Barnaby assumes, I observe, that it is almost necessary that a ship when she is heavily armoured, should have few effective guns; that is a point that I demur to. She will have few effective guns as against a ship heavily armoured; but it does not follow that she will have few effective guns as against a ship which is not armoured at all. The battle of Lissa was referred to by Sir John Hay, and there we had a lesson which seems to me to settle that question, so far as Admiral Touchard goes, completely. The "Kaiser," the two-decker, an unarmoured ship, which did as good service as she could in that battle, was out of the action very early in the proceedings, and her loss in killed and wounded was two-thirds of the whole loss of the Austrian fleet. I think that is a fact which settles the question completely. Here was a ship such as Admiral Touchard would wish for, I suppose, with a large number of guns. She was set on fire in two or three places. She lost her masts, was thrown out of action altogether, and became quite a burden to the fleet; and she lost two-thirds of the whole loss of the Austrians. The Lecturer lays great stress upon the armouring of the bows and sterns of his vessel, and Admiral Touchard, I think, lays great stress upon the same thing. (Mr. BARNABY: The bow only.) In the course of Mr. Barnaby's lecture he pointed out to us that the "Glatton" turret was so small an object that its real defence lay not in the thickness of armour-plates upon it, but in the smallness of its size, so that it could not be hit. Now I look upon it that the bow of a ship is in precisely the same condition. It will be a most difficult thing to hit the bow of a ship at all. It is a very small target, and I think you had better trust, where you are seeking to save weight in every way you can, to the smallness of the target than to the thickness of the armour you put upon it. There is one thing that I can see through this discussion, namely, that it is quite clear we have not settled in the least how we propose to fight our battles; and I am

persuaded that until we have taken some steps to settle how we are going to fight our battles at sea it is very little use our trying to build ships to take part in battles that may not afterwards be those which we shall be called upon to fight.

Commander W. Dawson, R.N.: I should like to correct an erroneous impression which might be caused by a statement made by me at the previous discussion. I then congratulated the Controller's department on the fact that they had discovered that a ship-of-war was built for the purpose of carrying guns and making holes in hostile ships, and not exclusively for keeping out hostile shot. I supposed that that principle had been carried out in the design of the "Téméraire" placed on the walls. My congratulation, however, referred rather to the principles laid down by Mr. Barnaby in the paper than to the design for the "Téméraire." It was only when I got home and began to reflect still further upon this important and valuable paper, that I found the offensive power given to the "Téméraire" did not embody in an adequate degree the principles of armament so ably enunciated by Mr. Barnaby. The ever-decreasing character of naval armaments is shown by comparing the weight of ordnance carried by successive types of ironclads. The "Northumberland" carries 261 tons of ordnance, but the "Hercules," with thicker armour, carries only 197 tons of ordnance, or somewhere about one-fourth less; whilst the "Bellerophon" carries only 145 tons of ordnance, or little more than one-half the offensive force of the "Northumberland." Now this new "Téméraire" carries only 165 tons of artillery, so that offensively she is about two-fifths less powerful than the "Northumberland." The abandoned design before us would have carried a slightly greater weight of ordnance than the "Northumberland," for she would have had 272 tons. Now, as I place the greatest reliance upon the offensive power of ships in battle, which, with guns of equal perforating power on both sides, would be far more decisive of victory than their defensive armour, I would on that ground have been prepared to adopt the abandoned design. But I am not quite sure that it would be wise to go so far as Sir John Hay proposes, and as is proposed in the abandoned design, by abandoning armour protection altogether. I fully concur with what has fallen from my friend, Captain Colomb, that there is a great benefit derived from comparatively thin armour in obliging the enemy to carry heavy ordnance, and thus to fire few shot which will not perforate at great angles. For example, let a ship with 4½-inch plates, like the "Warrior," be opposed in action by an unarmoured ship such as the "Narcissus," and the case will be represented to perfection. Not one of the "Narcissus's" guns, as at present armed, could perforate the "Warrior's" armour under any circumstance; whilst even the boat's guns of the "Warrior" would do good destructive work against the sides of the "Narcissus" at almost any angle of incidence. So that whilst the "Warrior" would be quite safe against the "Narcissus," the "Narcissus" might be riddled at leisure even by the boat's guns of the "Warrior." Your thin armour, therefore, compels the enemy to re-arm his fleet. That re-armament, or re-distribution of ordnance into fewer and heavier pieces, is one of the most urgent necessities of our own fleet—namely, that existing vessels, armoured and unarmoured, should be all re-armed, so as not to be compelled to run away from a thicker sided foe, but be competent to fight whatever ships of equal weight of metal they may happen to meet. This can only be done by increasing the velocities of the shot or their weight, and though it is the rifling which causes British guns to have "decidedly the lowest velocities," yet an increase in the weight of the guns would be necessary to secure perforation in all cases. The point which I wish to emphasise is that the power of the ship is not to be measured by the thickness of the armour, but by the force and number of the blows she can give the enemy, and her power of artillery penetration.

Captain Selwyn, R.N.: I shall ask to be allowed to say a few words upon the questions that Mr. Barnaby has proposed to us, and I may say before I do so, as Major Moncrieff has been adverted to, I know that he is at this moment engaged at Newcastle inspecting a gunboat built for the Dutch in which his principle has been applied on the hydropneumatic plan, and which I believe has been a perfect success. There is no difficulty whatever on that principle in bringing any gun you like to use, entirely below the water-line whenever it is not actually firing. That disposes of the question in great measure as to covering the guns.

With regard to the question for what purpose we put armour on our ships, I

think my naval brethren have given a very short answer to that. Not even Mr. Plimsoll, with all his value for Jack Tar's life, could ever persuade sailors to think the ship that carried them was not worth more than any of their individual lives. We are all willing to abide by the ship that carries us, and we want her protected first and before all. But we want her protected intelligently; we do not want a quantity of iron devoted to protecting the ship which really neither protects the guns nor the ship. In the enormous broadsides which we see in our modern armour-clads, I should like to ask how much of the armour actually protects the ship's life, and how much actually protects the lives of any men fighting the guns? how much, again, protects the machinery, if it be properly placed where it ought to be placed, within the protection of the water? It is the want of skill in the distribution of the weight; the idea that it was necessary to armour-plate the whole outside, that has led us into the difficulty which I am happy to see Mr. Dudgeon says is no difficulty at all, of not being able to carry enough armour where it ought to be placed and where it is wanted. If we carry our guns below the water-line, and by dint of intelligent machinery are able to bring them up to fire, we certainly do not want armour to protect the guns, and equally little to protect the crew, because they remain below water. We should want armour very much indeed to protect the machinery of the guns if we were to attempt to carry guns "*en barbette*." That is a term that I do not accept as applicable to anything which floats on the ocean. *En barbette* is to be applied where the plane is absolutely steady at all times and in all weathers. That is never to be expected in the case of a ship. Whether it be from the curved fire of a distant enemy, or from the rolling and other movements of your own ship, a barbette gun is exposed in every direction; and the same objection precisely applies to any idea of a traverse at the bows or stern of a ship. There is no time during the approach of two ships to each other from the distance at which they begin firing till they come up very close to each other, at which they may not expect to receive a plunging fire, whether of grape or shrapnel, or even of shot and shell bursting at proper distances all along that deck, in spite of the traverse at the bow. Therefore I do not regard any contrivance which is thought out simply as though the ship were constantly floating on a plane, as having any value whatever at sea, and I should beg the reconsideration of that whole subject.

I will now proceed to the question of how much armour ought to be given to the guns and to the ship. I have shown that really no armour ought to be necessary for the guns at all: how much, then, is necessary for the ship? In the case of the ram and torpedo, there is no possible thickness of armour and no possible protection on which we could rely. One of these ships going at five knots, let alone ten, twelve, or fourteen, would drive through armour and everything else, as if it were so much pasteboard, and I do not believe that there will be any of the little fiddling about, so beautifully word-painted by Admiral Touchard, but which would simply result in saying, "I will give you a little poke in the ribs now, and then I will go away and just touch you somewhere else." The very first time a ship is fairly struck by a ram, unless she is very much more protected than she is now, she goes to the bottom, that is quite certain, and with very little damage to the attacker, wonderfully little damage to the moving object. Admiral Sir George Sartorius foresaw a great deal of this, and I think if his opinions had been more weighed at the time, we might have got faster forward than we have. As Sir John Hay has said there is another question which will answer many of these questions. Why do not I want any protection from torpedoes? Provided that it does not blow the ship to pieces altogether, no amount of water that could enter the ship would suffice to sink her, if that ship were moved by a turbine propeller. Secondly, Sir John Hay very properly said, speed was one of the great conditions we seek. Why is it undervalued? We say, speed can be obtained by the turbine propeller which no other form of propeller will give, simply because it is not dependent on the immersion of the propeller for the degree of propulsion it can give. As the late Mr. Murray told you here, its power is simply dependent on the engine-power you can develop in the ship; you can drive the ship at any speed you please, of course with a certain increase of boiler power. Therefore no armour is necessary to secure the ship against sinking if she be properly engined. Her steering power, another great point, as Sir John Hay has said, is very much subject to that question of the turbine; we do not want armour

again for the stern. I do not care about the rudder; the rudder is of no more account to me for the purpose of steering. The instant I get a proper propulsive engine I do not want to protect the bows at all, because I do not propose to place the guns there, and having no idea that when I can use the ram, the gun will be used in preference. I may confine my armour then very much to the interior of the ship, not to the exterior. It is quite possible to build ships well without putting armour outside their skins. The skins will not be much hurt by being pierced above water; you may allow them to be pierced as much as you please. If you wish to do it, you may confine your armour inside to a very much smaller perimeter than your external outline. That will economize weight. If you try to do away with armour altogether, I join entirely with my brother officers in saying, you can never persuade me that the man who is not protected from any shot or shell, is better off than he who is protected against some, but not all; and you can never persuade me that human beings will fight better in proportion as they have less protection. Let us lighten the ship reasonably. Let us strive rather to accumulate our protection on those points which do need it, and do away with it on those points where it is not essential, and on which Officers at sea will tell you we could very well do without it. We would much rather that you would not load us with great weights at the bow and stern; we will sacrifice a great deal in order to keep the weights out of the bow and stern, for the ship will be more handy, more ready to encounter heavy weather, and will strain less at sea. The first weights we have always got rid of at sea, when in danger, are those of the extremities. Then, if you send us to sea in vessels with masts, let us have masts so placed and so proportioned that the ship will wear and stay with these masts, for if she will not, you had better never put them there at all. As for impossible sails calculated on centres of effort which do not exist at sea, things which no seaman on earth can handle in any sort of way, I say, sweep them away altogether, do not give us a pretence, do not jury-rig us on leaving port. I think there is talent sufficient in the Navy, and I hope in the Controller's Department, to put masts where they ought to be in the ships. I am sorry to say we have not seen that very desirable circumstance fully carried out in the ships which have been sent to sea of late years; they have been more remarkable for the extreme persistence with which they pursue a straight course when their captain wishes them to turn round, and with which they turn round when their Captain wishes them to do the reverse. They are not seamen's vessels; in fact, I have often said before, they never will be seamen's vessels till those who build them first pass some portion of their early life at sea. It will conduce very much to their health, and I hope to their knowledge.

The Chairman: I did not come here to discuss these points, but to hear the opinions of various gentlemen. From what has been said, and the opinions that have been expressed, it appears that most Officers are of opinion that the first point, in answer to Mr. Barnaby's questions, is to protect the vessel from being sunk by shot, or by a ram, or by torpedoes; but that when you come to add by a ram, or by torpedoes, it makes it a very difficult question indeed to answer, how you are to dispose of this iron—how you are to protect her, if she is to be protected with iron—where you are to put the iron. It is quite clear that a narrow band of iron round a ship will not protect her from a ram, and it is also as clear that it will not protect her from a torpedo. The gentleman who has just spoken and Sir John Hay have rather a good opinion of the turbine. The turbine is good so far as this, that almost the larger the hole in the ship's bottom, the better the turbine will work. That is all so far true, if you can calculate upon a reasonable hole, but what I contend is,—and I am afraid it will be the case whenever any of these torpedos get under a ship's bottom,—that they will knock the whole bottom to pieces, turbine and everything else, and the vessel will be down in five minutes. There is the difficulty. I dare say you all know that torpedoes are now contrived with internal machinery that works not by steam, but by compressed air. These torpedoes will go at the rate of 8 or 9 knots for a considerable distance, and carry a sufficient charge when they strike or get under a vessel, certainly to blow her up.

Then, with regard to protecting the guns. I think it has been advocated that you had better have a good number of guns. Well, if you have a number of guns, it is quite impossible to protect them by armour. I have a great objection to go

back to the old system of a number of guns. What we ought to have is, few guns and heavy ones, and those few guns in turrets. What I believe to be about the most powerful vessel that could be constructed now-adays would be a ram, with one turret and two 35-ton guns. It would take very little armour to protect these guns, and the armour that protects the guns will protect the men. In fact there are no men to protect, for in the turret with two 35-ton guns you need not have above three men in the turret; all the rest of the crew can be below, under water. By the machinery we have to work these turrets with, the men are not in the portion of the turret in which the guns are fired; they are down below working the winches. With regard to the question whether armour that will not keep out shot, is worse than no armour at all, I think any Officer that had to choose between an unarmoured ship and one with the "Warrior's" armour would say, "I will take "the $4\frac{1}{2}$ inches, for that is better than nothing. I will never if I can help it, let "them have a fair shot at me. If I have the heels of my enemy I will keep my "bow on;" and $4\frac{1}{2}$-inch armour will keep out a shot from an 18-ton gun, unless it is a fair hit, and any gentleman who has been at sea will know that it is rather difficult to get a fair hit.

With regard to what Sir John Hay said about what vessels we want, I think that is the most important point of all. The vessels that we have got, or the vessels that we are now building, what are they fit for? What will they do? We are building a set of vessels now without masts, the most powerful vessels that have ever been built as far as guns go, but nobody knows what they will do. I understand they are built for sea-going ships, not cruising ships, but ships fit to go to sea whenever the service requires it, and to go abroad. Now we are not agreed upon that. Many naval Officers and architects say that these ships are fit to go anywhere. I have always had my doubts about it, but I never objected to build one. I was always an advocate for building one of those ships on trial. When Captain Coles was allowed to build his ship, we were of opinion that that ship never would be an efficient sea-going ship, nor a safe ship at sea. But there was a great difference of opinion on the subject. The public took up the idea and backed up Captain Coles, and what I said then was, let them build a vessel on trial. The Government allowed Captain Coles to build a vessel on trial, but we thought that Captain Coles' plan would not make her sea-going. We recommended a vessel like the "Monarch." Captain Coles' vessel was tried for a long time at sea, and it was thought that she was perfect. People began to say, "How mistaken you "were; how little you know about sea-going affairs;" and then we know how she was unfortunately caught in some particular sea, and a puff of wind sent her to the bottom. This shows that we ought never to build ships upon new designs without, the moment we have got one launched, giving her a fair trial—not a trial such as when a ship goes off in smooth water with a common sea in the channel and with an easterly wind—but whether she will stand an Atlantic swell. You have heard that the height of the Atlantic waves have been calculated at from 20, 30, 40, to 50 feet, and Admiral Fitzroy gives very good reasons for saying he has seen waves 60 feet high. When you build these low free-board ships to go to sea with a high centre of gravity, which is one of the most material points, I repeat you ought never to build a second until the first has been tried upon the point of seaworthiness.

Captain HOSEASON, R.N.: Is it out of rule for us to ask Mr. Barnaby, as he has kindly brought a new plan of a ship before us, if he would explain some other points connected with her besides those about the gun-battery? I should like to ask whether that is a full masted ship or not, and what her capacity for fuel is? There are also two ways of considering the value of a ship's battery at sea: in the one a ship that can steam long enough to keep a small battery for a *month* at sea, in the other, that of a ship that can only steam long enough to keep a larger battery a *week* or a *fortnight* at sea. The question turns upon the different services to which you wish to apply the ship, and it is a question whether a vessel with a less number of guns and more fuel is not under certain conditions much more efficient than another vessel with more guns and with less fuel. We know nothing about that ship (pointing to the diagram) except as regards her gun battery. We do not know whether she is a full masted ship or not. I have had a pamphlet kindly sent to me by Sir Thomas

Symonds, in which he designates all our ironclad ships as built on an insane principle of being over-masted. I want to know if this ship is one of those that will come under that category. It is evidently a new ship, and, I believe, she is approved of. What is her sail power?—what is her steaming power?—and what is her speed?

Mr. BARNABY: This (open battery) ship of course does not exist at all: the question is put to me with regard to the "Téméraire." The "Téméraire" will have two masts only.

Captain HOSEASON: Auxiliary area of canvas or primary?

Mr. BARNABY: With about the same area of canvas as is given to the armoured ships of the "Iron Duke" class. The speed under steam is expected to be 14 knots. The coal endurance will be at least 50 per cent. better than that of any of the present ironclads.

Captain HOSEASON: Is that due to improved engines, or to the quantity of coal carried? Do you mean to say she will carry 50 per cent. more coal?

Mr. BARNABY: I do not.

Sir JOHN HAY: Not the "Devastation"?

Mr. BARNABY: No, the masted ships. The quantity of coal I am speaking of is the quantity called the complement of the ship; but the Controller of the Navy has insisted on having the bunkers made large enough to carry a much larger supply of coal than is usually carried.

Captain HOSEASON: What is the amount?

Mr. BARNABY: It is not of much value to tell the amount, because the size of the ship ought to be taken into consideration.

A VISITOR: How many days full steaming?

Mr. BARNABY: About 3½, but that is not the way in which the matter should be looked at.

Captain HOSEASON: It is not the way I should look at it, but I should better understand it if you will give me the *bonâ fide* number of tons.

Mr. BARNABY: The "Téméraire" will carry 500 tons as her complement; she carries 700 tons, but 500 tons is her complement.

Captain HOSEASON: What is her displacement?

Mr. BARNABY: 8,300 tons.

Captain HOSEASON: Then her economy is entirely due to the principle of the engines.

Mr. BARNABY: Entirely, but the bunkers are made large enough to contain a larger quantity of coal than is the proper complement of the ship.

The CHAIRMAN: The vessel is not a fully masted ship?

Mr. BARNABY: She is masted like an ordinary ironclad.

Captain HOSEASON: Is she masted as much as the "Bellerophon"?

Mr. BARNABY: No, because she has two masts and the "Bellerophon" has three.

The CHAIRMAN: The question about them all is, that they are unmanageable. The hull is so heavy for the force of the sails that you cannot manage them. They have not sail enough. Is this ship masted in the same proportion as the other ironclads?

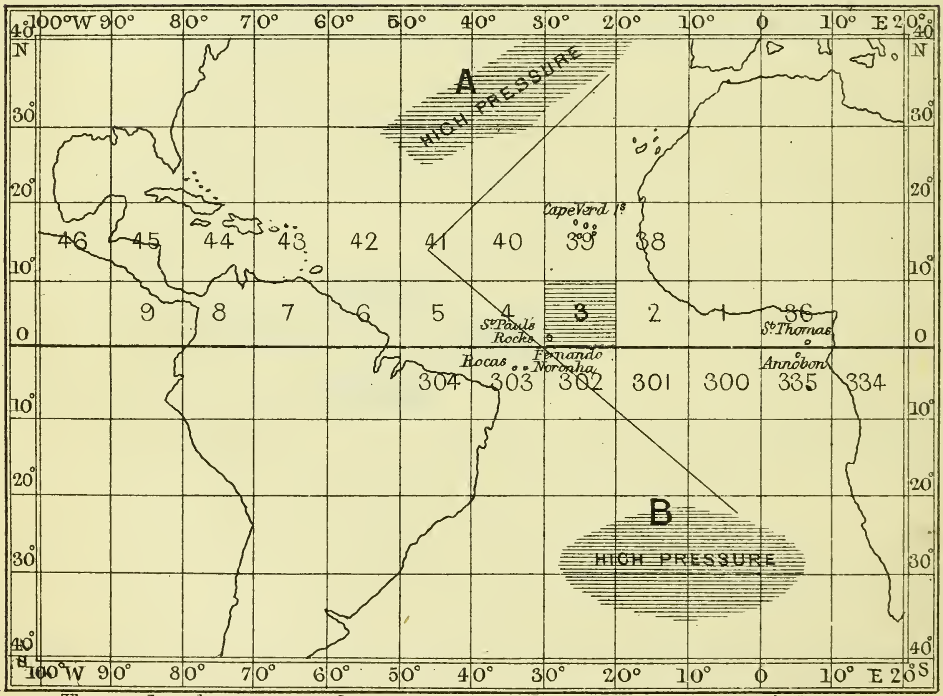
Mr. BARNABY: We are getting now into the very important question, "How are "you going to mast ironclads?" which needs half a dozen lectures in itself. There are gentlemen who believe that you can make an ironclad sail as you can make ship that is not armour-clad, but you cannot do so.

General SCHOMBERG: Would you allow me to ask Mr. Barnaby whether he would describe how the French guns are placed, in order, as Admiral Touchat states, to deliver a broadside before ramming?

Mr. BARNABY: The idea is impracticable, I think. Allow me now to say that I am very much indebted to the gentlemen who have been kind enough to help us to discuss these questions this evening.

The CHAIRMAN: In the remarks I made with regard to the trial of the new ships I did not allude to the necessary trials with regard to their stability, but when they are forced against those seas. I think, gentlemen, you will allow me to thank Mr. Barnaby for the very excellent lecture which he gave us; and I hope that some good result either to us or him may follow from the discussion. The great point in all these discussions is, if possible, to come to some decided conclusion; we vary in opinion, and very often the subject is left as open and wide as when we began.

DIAGRAM 1.



The numbered squares are those for which data have been extracted from logs, and sifted into 1° sub-squares.

A *and* **B** *are areas of high barometric pressure which supply air to the Trade and other winds.*

J. Jobbins

LECTURE.

Friday, April 4th, 1873.

Vice-Admiral SIR FREDERICK W. E. NICOLSON, Bart., C.B., Vice President, in the Chair.

THE METEOROLOGY, SEA TEMPERATURE, AND CURRENTS OF THE 10° SQUARE OF THE ATLANTIC, WHICH LIES BETWEEN THE EQUATOR AND 10° N., AND FROM 20° TO 30° W.

By Captain H. Toynbee, F.R.A.S., Marine Superintendent, Meteorological Office, Board of Trade.

Much good work has been done by Maury, whose death we have now to lament after a long and able life chiefly devoted to the Science of Meteorology, also by Admiral FitzRoy, the Hydrographical Department of the Admiralty under Admiral Richards, and others, towards representing in a general way the wind and other weather data of the Atlantic; but now that the Meteorological Office has been supplying standard instruments for 18 years on the plan commenced by Admiral FitzRoy, and receiving logs in which the force of the wind is always entered, it seems right that certain important parts of the sea should be dealt with in a more special way.

As the Equatorial Doldrums are of the greatest importance to navigators, especially in sailing ships, it has been decided to commence with them.

Here it may be well to say that the doldrums are the calms and unsettled weather which exist between the trade winds; they travel N. and S. after the sun; and pass twice in the course of a year, through the square with which we are about to deal. If any of my hearers are afraid of forgetting their name, they have only to pass *once* through them to have it impressed on their memories for ever.

The 10° square (No. 3 of Mr. Marsden's numbered squares) extending from the Equator to 10° N., and from 20° to 30° W., has been selected as the one of most importance, and in which the largest number of observations have been collected.

In that *zone* of the Atlantic which lies between the parallels of 20° N. and 10° S., shown on diagram 1 by the numbered squares, we have extracted nearly 125,000 observations, and, although they extend

over the twenty-six numbered squares, we find that nearly 60 per cent. of the whole were taken in No. 3 SQUARE, which, for distinction, is slightly *shaded*.

The data for this square have been sifted into monthly charts containing a hundred 1° sub-squares; that for January was lithographed and circulated amongst scientific and practical men interested in the subject; the result has been a large number of suggestions which are embodied in the chart, containing twenty-five 2° squares, now exhibited. It gives graphic representations of the direction and force of wind, the amount of calm, and the prevailing currents, besides giving the original observations. Reductions of the diagrams I am about to use will be on the corners of the charts.

Mr. Francis Galton, who submitted a short memoir in 1866 to the British Association (Transactions of Sections, p. 17), on the new principle of "passage charts," has very recently sent an elaborate communication on the same subject to the Royal Society, which will be read at an early meeting after Easter. In this memoir, he not only shows how to compute the mean distance sailed in a day, in any direction, in any square, by ships of a specified class, but he explains how the tedious calculations may be wholly dispensed with by the use of a small machine; he also shows how isochronic charts are to be constructed, and how they are to be used in connection with the actual and probable conditions of wind under which a navigator may find himself.

In the last letter which I received from the much-lamented Maury on the subject of the January Chart of one degree sub-squares, which had been sent to him, he said:—

"Being such a highway, in which observations are so frequent, and being in a meteorological position of such importance as it is, viz., at the meeting of the trade winds in the doldrums, and in the wedge of the westerly monsoon that feeds the springs of the Niger; all these circumstances conspire to make it an inviting field of research. Wisdom has been displayed in the selection of this square for minute investigation."

"These investigations are in continuation of the wind and current charts, and they not only confirm several important discoveries announced in the 'Sailing Directions,' as they were uttered, but they develop for the first time other phenomena of a highly important and interesting nature." . . . . . . "This is a most valuable contribution to our knowledge touching the physics of sea and air. It is of practical use to navigators also, and I thank you heartily for it."

This letter was followed by another from his daughter, saying that her father had been very unwell, but was again convalescent, and hoped soon to write to me respecting the paper "On the weather which prevailed about the time that the 'City of Boston' was lost."

The promised letter never came, but very shortly afterwards we had the sad news of his death.

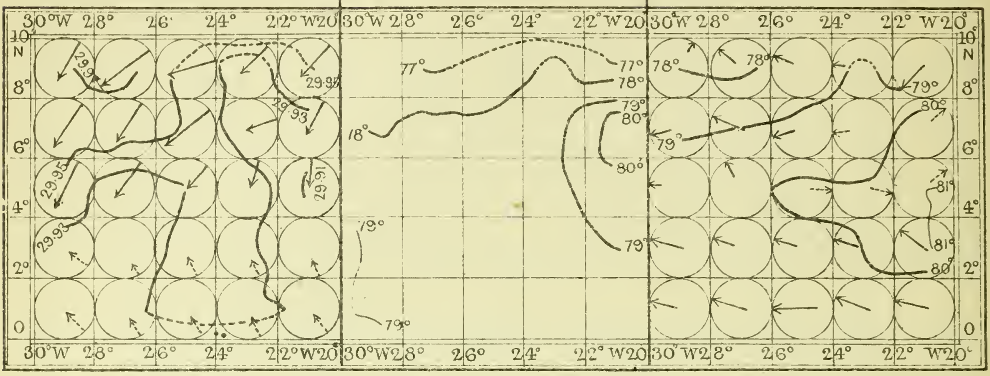
We will now, if you please, turn to the diagrams, and I must ask your particular attention for a few minutes whilst I endeavour to give a general idea of them. Although they are numerous, there are only

JANUARY.

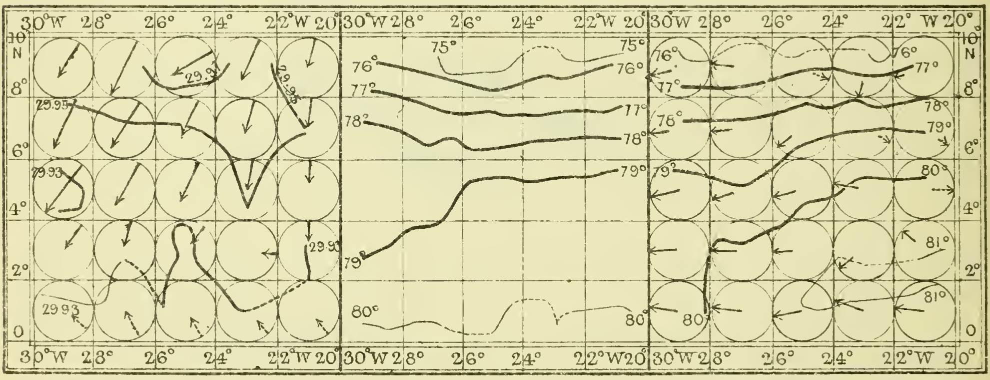
ISOBARS FOR EACH ·02 OF AN INCH AND PREVAILING WINDS ✱ †

ISOTHERMS OF AIR FOR EACH DEGREE FAHRENHEIT.

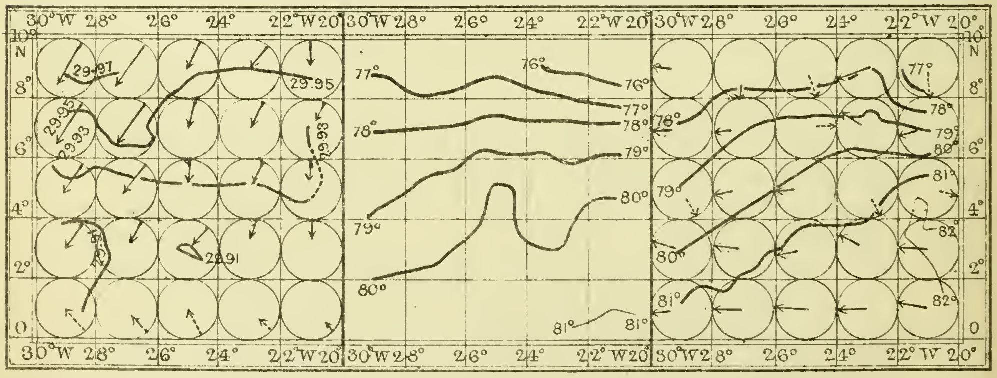
ISOTHERMS OF SEA FOR EACH DEGREE FAHT AND PREVAILING CURRENTS † ‡



FEBRUARY.



MARCH.



NOTE. *When the Isobars or Isotherms are deduced from the data of 1° squares they are represented by a faint continuous line. Broken lines merely connect the different parts of an Isobar or Isotherm when the data does not authorize its being drawn.*

✱ *Each arrow flies with the most frequent wind of its square. Its length shows the mean force up to 5 of Beaufort's scale, and is proportional to the rate per hour at which the wind would drive Beaufort's Ship. Nine miles an hour (force 5) extending across the circle.*

† *Northerly winds and Westerly currents have continuous, whilst Southerly winds and Easterly currents have dotted arrows.*

‡ *The length of the current arrows is proportional to the rate in 24 hours. 50 miles extending across the circle.*

J. Jobbins

three for each month, and when you understand one set you will understand all. As already remarked, they are enlarged representations of the small diagrams which will appear on the lower right-hand corners of the charts for the various months, and which are published with this lecture; they represent—

1st. *Isobars*, or lines of equal barometric pressure for every two-hundredths of an inch, on which are drawn arrows flying with the prevailing or most frequent wind for the month in each 2° square. Northerly winds and westerly currents are shown by plain arrows, southerly winds and easterly currents by dotted arrows. The length of an arrow is in proportion to the force of the wind; if it amounts to 5 or more of Beaufort's scale, or 9 miles an hour of his ship, it extends across the circle.

2nd. *Air-isotherms*, or lines of equal air temperature for each degree Fahr.

3rd. *Sea-isotherms*, or lines of equal sea-surface temperature for each degree Fahr., on which are drawn arrows flying with the prevailing current for the month in each 2° square. The length of an arrow is in proportion to its rate in 24 hours, 50 miles or more extending quite across the circle.

My hearers must remember that winds are named after the direction *from* which they come, whilst currents are named after the direction *towards* which they go; for instance an arrow pointing to the north-westward represents a S.E. wind, but a N.W. current. In the diagrams, the *tails* of the wind arrows and the *heads* of the current arrows are made to touch the circle at the points of the compass after which they are named.

The remarks on Natural History are necessarily vague, sometimes because a Captain may not know the right name of a bird, fish, or other creature seen, at other times from his having an indistinct view of it; still they have been thought worthy of extraction.

January.

Isobars and Wind Arrow (see the monthly diagrams).—We will now turn to the isobars for January. That of lowest pressure (29·91) is on the eastern side of the square, and it increases to 29·97 in the north-western corner; they are also much closer together in the north-western corner than elsewhere. Now the relative length of the wind arrows shows that the N.E. wind is much stronger in this north-western corner, where the isobars are closest, than in the rest of the square, showing the relation between the difference of pressure and wind force.

The dotted southerly wind arrows are much shorter than the plain northerly, indicating how much stronger the N.E. trade is in these parts in January, than the S.E. This is a month in which the N.E. trade is pressing its way to the southward. By referring to the diagram for December, the eye can make a very fair estimate of the monthly change.

First, we find that the isobar of 29·97 which only just showed itself

in December has now pressed well into the square, in fact isobars 97, 95, and 93 have each come about 2° to the southward.

Then again the N.E. trade which only reached 6° N. in December, is now down to 4° N., and it has decidedly increased in force; between 6° and 7° N. we find that it has increased 0·7 of Beaufort's scale, or about $1\frac{1}{2}$ miles an hour of his ship.

The S.E. trade still prevails from the Equator to 4° N., but it has decreased very much in force over the whole zone, the decrease amounting to $1\frac{1}{2}$ miles an hour in the speed of Beaufort's ship. This seems to show how in January the rarefaction of the air, during the summer months of the southern hemisphere, has rendered the pressure to the south of the Equator, close to our square, nearly the same as in the doldrum, so that the greatest rush of air into the low pressure of the doldrum is from the northward, where the cold air lies low and heavy. We also find that in January there is a great increase in the percentage of upper cloud moving from the south-westward, whilst there is a decrease in that of upper clouds from any northerly direction.

Isotherms of Air and Sea.—The isotherms of air for January show that the hottest air is in nearly the same position as the lowest pressure and hottest sea; since December the coldest air and sea have made their appearance in the north-eastern corner of the square where the hottest had existed since October; this sudden change seems to be due to the southerly progress of the N.E. trade carrying with it the southerly and south westerly current along the coast of Africa.

A paper "On the Currents and Surface Temperatures of the North Atlantic Ocean," (Official No. 12) published by the Meteorological Office, shows that in December the sea-isotherm of 80° is in and to the northward of the north-eastern corner of SQUARE 3, whilst in January that of 70° nearly touches the same part of the square. These facts support the wonderful changes which we find since December.

Here attention may be called to the great similarity in the trend of the isotherms of air and sea, also to the fact that the sea is nearly 1° warmer than the air. This difference is very much the same throughout the year.

Current Arrows.—The plain current arrows show a prevailing and moderately strong westerly or rather W.N.W. current from 0° to 4° N.; whilst there is a westerly and sometimes south-westerly current from 6° to 10° N.; between these, in the neighbourhood of the hottest water, we find the dotted arrows showing an easterly current. Now the prevailing wind arrows show us that the easterly current is in the doldrums between the two trades, where there is little or no wind, but no doubt a heaping up of the water caused by the meeting of northerly and southerly winds, hence it is reasonable to suppose that when the wind which drove the water has stopped, it will return to the eastward as a back drift; it may well be the warmest water, for it has been the longest in the tropics. So here we find the lowest pressure, lightest wind, warmest air and water, and an easterly current in nearly the same part of the square.

On comparing the sea isotherms of January with those of December,

we find that the temperature of the sea has increased in the southern part of the square, whilst we have before remarked that it has greatly decreased in the northern. We cannot be surprised at this increase, for the water forming the westerly drift of the S.E. trade is brought up from a part of the sea which has been exposed to the southern summer's sun, whilst that brought down by the N.E. trade has been exposed to the northern winter. Now that the coldest water is in the northern part of the square we find the largest amount of dew there also; in December it was over the cold water to the southward. Another interesting fact is that with this increase of dew comes a large amount of red dust from Africa; in the north-eastern corner of the square there is 48 per cent. of mist or haze, whilst in the south-western there is only 5 per cent. In the north-eastern corner we have such remarks as:—

"Air very close and suffocating. Very damp. Sun not seen below "8°, on account of the thick haze. All the sails and ropes red."

So here we have, in the north-eastern corner of the square, a mixture of moisture and dust, which must remind all who have been in Madras during March, of the effect of the "'long-shore" southerly winds, which mix the moisture from the surf with the brick-dust of the roads, and produce a paste which partially closes the pores of the skin, and is believed by many to cause the boils which are so very common at that season.

Remarks.

Winds.—All steady winds, of a force of 7 or upwards, were from the north-eastward, also 64 per cent. of the squalls. The steady strong winds were all on the western side of the square. Between 3° and 5° N. there are terrific squalls from the north-eastward.

Currents.—An outward bounder, near St. Paul's Rocks (see the south-western corner of square 3 on Diagram I), had a strong westerly current of 2 miles an hour, still she got quickly to the southward, and only tacked to the eastward for 4 hours.

Clouds.—At the southern limit of the N.E. trade, upper clouds were seen to move from the south-eastward, whilst further north they came from the south-westward, as if they were affected by the motion of the earth.

Weather.—Lighting was most frequently seen on some northerly bearing, from 0° to 4° N., and on some southerly bearing from 4° to 10° N., indicating that its origin was where the two trades met.

Heavy chain-lightning and "corposants" were seen between 5° and 6° N. There was an awful thunder-storm, with "corposants," at the mast-heads and yard-arms, between 9° and 10° N., during which time the wind was southerly, though well in the region of the N.E. trades.

Natural History.—Very few land birds or insects were seen: they were chiefly in the doldrums, between 3° and 7° N.

Sperm Wales were seen between 4° and 5° N., and again between 8° and 9° N., both times going to the north-westward.

Falling Stars.—Falling stars were most abundant, in 1860, between the 1st and 5th instant.

Temperature of Rain.—The mean of ten observations showed the rain to be 2° colder than the air.

Various.—A severe shock of an earthquake was felt at 1 p.m., the 25th, 1859, within 10 miles of St. Paul's Rocks.*

Red dust was seen on the sails and ropes, chiefly between 7° and 10° N., where more than 40 per cent of the weather observations recorded mist or haze.

Best Route across the Equator.—A careful study of the data in SQUARE 3, and of that in the squares to the northward and south-westward of it, leads to the supposition that it would be well, for both outward and homeward bounders, to keep in its western half whilst passing through SQUARE 3.

February.

Isobars and Wind Arrows.—In February, we find the lowest pressure (29·93) ranging across the square in about 2° N., whilst that of 29·95 is in about 7° N., and 29·97 in 9° N. All have advanced to the southward since January, and the pressure of 29·98 frequently shows itself in the northern part of the square.

The isobars are still closest in the north-western corner of the square, where the prevailing north-easterly wind is strongest. The N.E. trade is not only stronger but more easterly on the western than on the eastern side of the square. From 2° to 10° N., between 20° and 22° W., the prevailing wind is nearly due north, whilst between 28° and 30° W. it is about N.E. by N.

The N.E. trade has gained 2° to the southward since January, and now extends to 2° N.

The S.E. trade has retreated 2° to the southward before the N.E., and decreased in force since January. It is strongest on the western side of the square.

Isotherms of Air and Sea.—The similar trend in the isotherms of both air and sea seems worthy of notice, as, also, the fact that the sea remains about 1° warmer than the air.

The air isotherm of 75° (being the coldest air in SQUARE 3, due to the N.E. trade), shows in the northern part of the square this month.

The temperature of both air and sea has decreased in the northern and increased in the southern half of the square. Between 9 and 10 N., the air has decreased 1°·8, the sea 1°·5, whilst, between 0° and 2° N., the

* The following is the complete extract from the log: "St. Paul's Rocks bearing N.W. by N. by compass, distant about 10 miles, experienced a severe shock of an earthquake, if that term may be applied to what occurred at sea. It commenced with a rumbling noise like distant thunder and lasted about forty seconds. I am perfectly familiar with earthquakes, having experienced many on the West Coast of America; but I never felt one so severe as this. Glasses and plates that were on the table jingled to a great extent, several articles were shaken off the after-hatch, and the ship felt as if grinding heavily on a reef of rocks, and that she was doing so found general belief, for the cry of "the ship's ashore" burst simultaneously from the lips of all on board, and the watch below came tumbling up in great haste. I must confess that I was very much startled, and ran to the side to look for the bottom, but I soon remembered what it was. During the first part there was a small confused sea, but after the earthquake a heavy swell from N.N.E."

air has increased 1°·5 and the sea 1°·1. There has been no change in the mean temperature of the air between 5° and 6° N., and none in that of the sea between 4° and 5° N. In spite of these great internal changes, the *mean* temperature of the whole square has not changed since January, but the difference in the position and trend of the various isotherms for the two months, shows the importance of this more minute work.

Current Arrows.—Westerly currents prevail in the square, the strongest being between the equator and 2° N., where the S.E. trade prevails.

Easterly currents still show, on the eastern side of the square, between 4° and 8° N., they are where the prevailing wind is northerly. Between 4° and 5° N., south-easterly currents prevail over all others.

Remarks.

Wind.—The remarks on wind show that there were some smart squalls in February, and that the wind is more unsettled on the eastern than on the western side of the square.

Currents.—There is only one mention of current rips between the equator and 2° N., whilst they abound in other parts of the square.

Clouds.—The remarks on clouds are similar to those for January.

Weather.—The remarks on the direction in which lightning is seen show that its source is where the two trades meet. Between 8° and 10° N. no lightning was seen.

Natural History.—No mention is made of any land birds or insects having been seen in February, as though the doldrums were too far S. for them. It will, also, be noticed that the prevailing wind on the eastern side of the square is northerly, instead of being north-easterly or more from the land, as in the previous three months.

Stormy petrels seem to have been most abundant between the two trades.

Various.—The only mention of red dust was between 7° and 8° N., on the eastern side of the square.

Best Route across the Equator.—In square 39 (see Diagram I), in February, the winds to the westward of the Cape Verdes are decidedly stronger than those to the eastward by about a mile an hour of Beaufort's ship; and, as our diagram shows them to be much stronger on the western than on the eastern side of SQUARE 3, there can be little doubt that both outward and homeward bounders should keep well to the westward, especially when we find that the homeward bounder would meet with a large percentage of north-westerly wind (the most trying of winds) on the eastern side of the square, whilst they do not exist on the western side. The winds near Cape St. Roque are favourable for getting to the southward in February.

March.

Isobars and Wind Arrows.—In March we find the lowest pressure (29·91) in the south-western corner of the square. The lowest monthly mean pressure for the whole square (29·931) exists in March.

The isobars of 29·93 and 29·95 have shifted to the northward since February, and that of 29·97 still exists in the north-western corner of the square. There has been a general decrease of pressure in the square, owing no doubt to the northern advance of the sun; the greatest decrease (·019) was between 2° and 4° N.; between 9° and 10° N. it had increased.

The isobars are still closest in the north-western corner of the square, where the relative length of the wind arrows shows that the strongest wind prevails; the wind arrows also show that the N.E. trade is still much more easterly in the western than in the eastern half of the square. North-westerly winds are common on the eastern side of the square.

The N.E. trade is more decided between 2° and 4° N. than in February: it has, however, slightly decreased in force generally. In February the northern part of the square was cooling whilst the southern was heating; now the whole is getting warmer, which may account for the decrease in force of the north-easterly wind.

The S.E. trade still prevails from the equator to 2° N., and is very little changed in force since February; it is strongest on the western side of the square.

Isotherms of Air and Sea.—The similarity in the trend of air and sea isotherms still holds, as also the fact that the sea remains about 1° warmer than the air. Their drooping to the southward on the western side of the square is no doubt a result of the stronger north-easterly wind there.

The mean temperature of both air and sea in the whole square has increased about 0°·6 since February, most in the south-eastern part of the square: the greatest increase was between 3° and 4° N., where it averages 1°·2 in the air, and 1° in the water. It seems worthy of notice that the greatest decrease of pressure has taken place where there was the greatest increase of temperature in air and sea.

Current Arrows.—The plain arrows show that westerly currents prevail generally, and are strongest in the southern part of the square.

The dotted arrows show that south-easterly currents prevail in the north-eastern part of the square, where the wind is chiefly from the northward, and not unfrequently from the north-westward. The chart of 1° sub-squares shows a large amount of southerly current between 7° and 10° N.

Remarks.

Wind.—The remarks on wind show that the N.E. trade acquired great force at times.

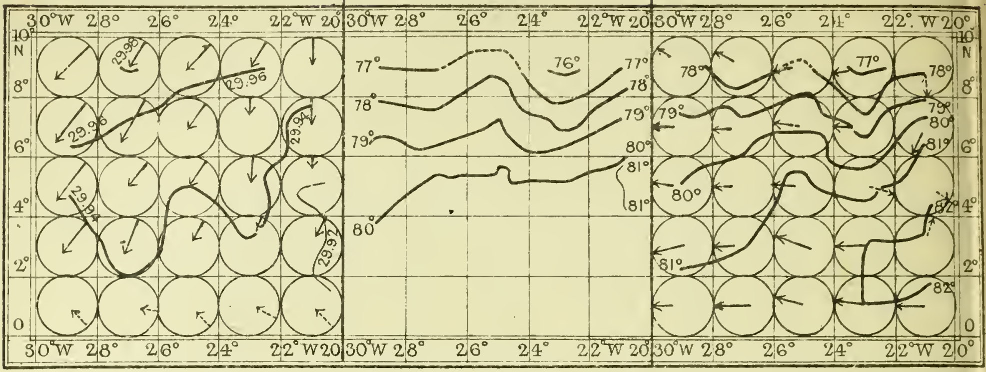
Clouds and Weather.—Those on clouds and weather lead to very similar conclusions to those derived from January.

Natural History.—A very large number of stormy petrels (nearly a hundred at once) were seen in the doldrums between 1° and 2° N. and 21° and 22° W.

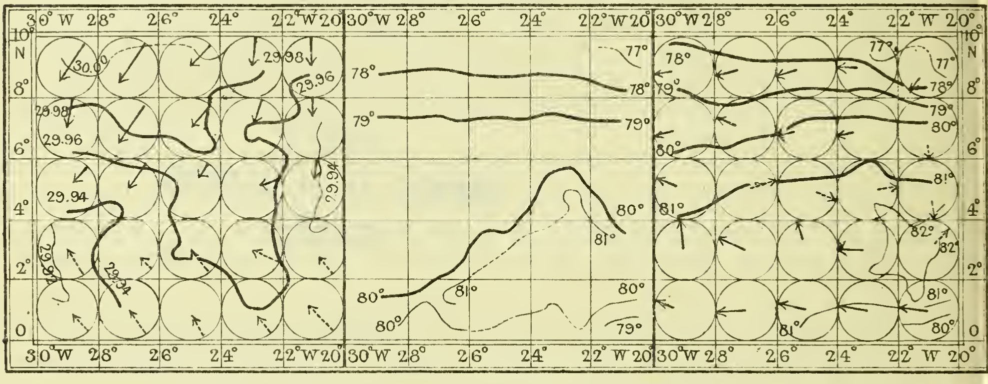
General.—Red dust is met with to the northward of 6° N. No land-birds or insects were seen, which may be well accounted for by the winds being so northerly on the eastern side of the square.

APRIL.

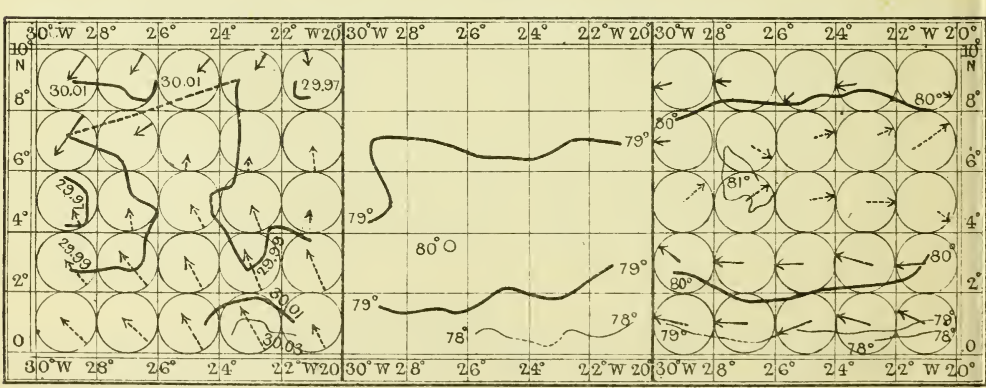
ISOBARS FOR EACH ·02 OF AN INCH AND PREVAILING WINDS. ✻ +	ISOTHERMS OF AIR FOR EACH DEGREE FAHRENHEIT.	ISOTHERMS OF SEA FOR EACH DEGREE FAHT. AND PREVAILING CURRENTS. + ‡



MAY.



JUNE.



NOTE. *When the Isobars or Isotherms are deduced from the data of 1° squares they are represented by a faint continuous line. Broken lines merely connect the different parts of an Isobar or Isotherm when the data does not authorize its being drawn.*

✻ *Each arrow flies with the most frequent wind of its square. Its length shows the mean force up to 5 of Beaufort's scale and is proportional to the rate per hour at which the wind would drive Beaufort's Ship. Nine miles an hour (force 5) extending across the circle.*

\+ *Northerly winds and Westerly currents have continuous, whilst Southerly winds and Easterly currents have dotted arrows.*

‡ *The length of the current arrows is proportional to the rate in 24 hours 50 miles extending across the circle.*

J. Jobbins

Best Route across the Equator.—In square 39 we find the strongest winds to the westward of the Cape Verde Islands in March, and they are decidedly stronger on the western side of SQUARE 3. The winds near Cape St. Roque in March are favourable for getting to the southward, so that an *outward-bounder* should keep well to the westward, and might safely cross the line in 27° W. A *homeward-bounder* should certainly keep to the westward.

April.

Isobars and Wind Arrows.—In April pressure has generally increased about 0·01 in., and the isobars run more north-easterly and south-westerly in their direction.

The greatest increase of pressure has been between 2° and 4° N. where the lowest pressure existed in March. This shows how gradually nature provides for the northern advance of the doldrum and its following S.E. trade, for in May we shall find that south-easterly winds prevail between 2° and 4° N., which could not be the case if there were not a higher barometer there than in the zone to the northward.

Both pressure and temperature have increased this month, which is rare; perhaps it is a kind of heaping up of the air before the increased activity of the S.E. trade sets in, causing freer egress to the upper current. The great amount of easterly wind experienced in higher northern latitudes at this season may be related to this heaping up of air in the doldrums; for before easterly winds can blow in our islands, the barometer must be higher to the northward than to the southward of them, and any check to the upper current which supplies air to the area of high pressure in about 35° N. would tend to produce such a state of things.

The plain wind arrows show that the strongest north-easterly wind is still in the north-western corner of the square; that the N.E. trade has increased in force between 2° and 4° N., especially on the western side of the square; also that between 20° and 24° W. the prevailing wind is still very northerly.

The dotted wind arrows show that the S.E. trade prevails up to 2° N., and that it is weaker and more easterly than the N.E.

Isotherms of Air and Sea.—The isotherms of air and sea are remarkably similar in their shape and position. The air still remains one degree colder than the sea. From the equator to 2° N. there has been a slight decrease in the temperature of the air, whilst that of the sea has increased. The sun having been a month in the northern hemisphere, we may expect the air of the S.E. trade to be cooler, as it would feel the change sooner than the water. The temperature of both air and sea is remarkably uniform from 0° to 5° N., but there is a gradual decrease of about 1° Fahr. to each degree of latitude between this and 10° N.

The hottest air (81°·4) and sea (82°·6) experienced in the southern part of the square during the year, appear in its south-eastern corner in April.

Current Arrows.—The plain current arrows show that westerly currents are the most prevalent throughout the square, whilst their relative lengths indicate that they are strongest in the southern part of the square.

The dotted current arrows show a back-drift to the eastward, near the spot where the hottest air and water are met with. By referring to the wind-chart for April we find a large per centage of light north-westerly winds and calms where this easterly current prevails.

Remarks.

Wind.—Very heavy squalls were frequently experienced, especially between 2° and 3° N., where some ships lost masts and sails.

Currents.—Current rips were very abundant throughout the square. It will be noticed that the prevailing wind blew very much across the prevailing current, especially in the northern part of the square.

Clouds.—The upper clouds were frequently from S.E. when the wind was N.E., as remarked in January.

Weather.—The largest per centage of lightning prevails between 3° and 4° N. The largest per centage of mist is between 6° and 7° N. It has decreased in amount since March.

Natural History.—Two swallows were seen in the doldrums between 3° and 4° N. A moth between 4° and 5° N.

A hawk devouring a stormy petrel as it flew, between 5° and 6° N.

A butterfly between 6° and 7° N.

Various.—Red dust was twice seen on the sails and rigging of ships between 7° and 8° N.

Best Route.—In April we find that the strongest winds are to the westward of the Cape Verde Islands, especially in the southern part of square 39°. The prevailing wind arrows show that the western side of SQUARE 3 has much the strongest winds. Then again we find that April is a good month for getting to the southward near Cape St. Roque, for although the winds are lighter than in other months, still they are very easterly in direction, so that a ship may safely cross the equator to the westward of 25° W.

MAY.

Isobars and Wind Arrows.—Pressure has generally increased about ·02 since April. The isobars still have a north-easterly and south-westerly trend.

The greatest increase of pressure has taken place in the northern and southern parts of the square, though it has been very equally distributed.

The plain wind arrows show that the N.E. trade has retreated 2° to the northward since April, and grown weaker in force, also that it is still much more easterly and stronger on the western than on the eastern side of the square.

The dotted wind-arrows show that the S.E. trade has advanced 2° further N. since April, and increased in force.

Isotherms of Sea and Air.—The isotherms of sea and air are still

very similar in their position, and the sea is about 1° warmer than the air. With both there has been a decrease of temperature since April in the south-eastern corner of the square, which is no doubt a result of the increased force of the S.E. trade. In the 1° sub-square, which is in the south-eastern corner of the square, the decrease of temperature is more than 2° since April. The temperature of both air and sea has increased in the northern, and decreased in the southern part of the square, so that the mean for the whole square is the same as that for April. The air is a little in advance of the sea in its changes, as would be expected, making it as warm as the sea in the N.

Current Arrows.—The plain current arrows show that westerly currents prevail, that they are stronger and more north-westerly in the southern than in the northern part of the square, where they are chiefly slightly S. of W.

The dotted current arrows show how the easterly current has gained ground with the decline in the force of the N.E. trade, also that it is still most common on the eastern side of the square where the winds are very light.

The distribution of wind and current in the square is very similar to that for January, only now the S.E. trade is advancing, whilst the N.E. is receding. It will be noticed that there is also a slight resemblance in the trend of their isobars and isotherms.

Remarks.

Wind.—The remarks on wind show that squalls were more abundant in May than in April. Very heavy squalls were most abundant between 5° and 6° N., where two whirlwinds were experienced.

Clouds.—The amount of cloud generally, as well as of rain, has increased considerably since April, probably caused by the in-rush of cold air from the southward.

Natural History.—A dragon-fly was seen between 4° and 5° N. Several land birds between 6° and 7° N. A hawk between 7° and 8° N., and a snipe between 9° and 10° N.

Various.—No red dust was reported in May.

Best route across the Equator.—In square 39 the *outward bounders* will find a stronger and more steady N.E. trade on the western side of the Cape Verde Islands. To the eastward of those islands there is a large percentage of N.W. winds, which are lighter than the N.E.

In SQUARE 3 the best wind seems to be in about 26° W., but perhaps it would be well to strike the parallel of 4° N. in about 24° W., as there is a S.E. trade and westerly current to the southward of this latitude, and the winds near Cape St. Roque are more southerly than in the previous months.

The *homeward bounder* would certainly do well to pass the parallel of 4° N. in about 26° W., seeing that he will thus escape thealarge amounts of light north-westerly and northerly winds which prevail in the north-eastern part of the square.

JUNE.

Isobars and Wind Arrows.—Pressure has increased at a mean

amount of ·034 over the whole square since May; this is the greatest increase during any month in the year. When we come to analyze this increase, we find that it amounts to ·06 between 0° and 2° N., whilst it is only ·01 between 9° and 10° N., now between 0° and 2° N. temperature has decreased nearly 2°, whilst between 9° and 10° N. it has increased to the same amount.

The isobars are irregular, and for the first time since October the highest pressure shows in the southern part of the square.

The plain wind arrows show that the N.E. trade has retreated 2° on the western and 4° on the eastern side of the square since May, also that it has grown weaker in force.

The dotted wind arrows show how much the S.E. trade has gained both in amount and force, backed up as we find it is by an in-rush of high pressure from the southward.

Isotherms of Sea and Air.—The isotherms of sea and air show that there has been an increase of temperature in the N. and decrease in the S. since May, so that now for the first time since November both are colder in the S. than in the N. The hottest air and water are now on the western side of the square in the neighbourhood of the lowest pressure.

Current Arrows.—The plain current arrows show that the westerly current between 0° and 4° N., which is due to the S.E. trade, has become more decided and stronger, but is still running a little to the northward of W., whilst that due to the N.E. trade only holds in a few 2° squares in the north-western corner of the square where the N.E. trade still prevails, it still runs a little to the southward of W. Between them comes the easterly, dotted-arrow, current, which inclines to the north-eastward into that corner of the square which has little or no wind, indicating how thoroughly it is a back-drift of water which has been heaped by the trades. It seems worthy of notice that the sea-temperature in the north-eastern corner of the square has increased 3° since May, which is no doubt caused by the appearance of the warm easterly current where there had been a south-westerly one.

The Admiralty Current Chart of the Atlantic Ocean says that in the summer and autumn months this easterly current extends as far as 53° W., and runs at a rate of 60 miles in 24 hours between 53° and 40° W., getting weaker as it comes to the eastward.

Remarks.

Wind.—Between 1° and 2° N. and 20° to 21° W. there were three or four heavy squalls from N.N.E., though the chart shows no surface wind from that direction; this looks like a downward rush from the upper current which abounds from N.E. at this season.*

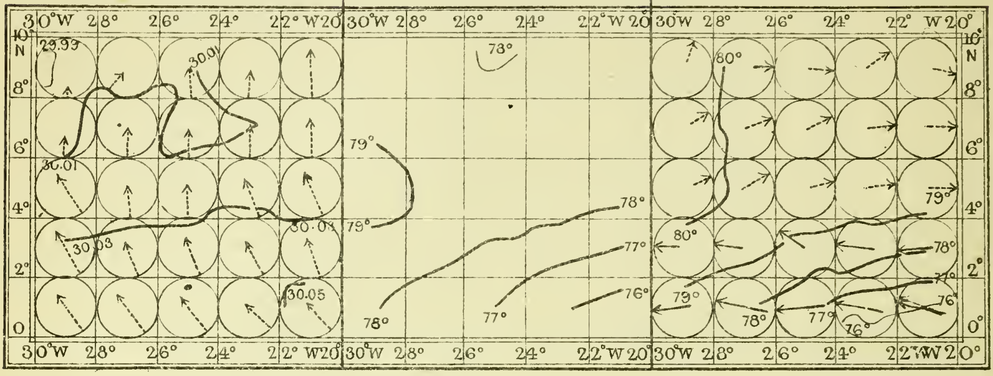
There was a most terrific squall, with thunder, lightning, and rain, between 5° and 6° N. and 21° and 22° W. Between 8° and 9° N. and 23° to 24° W., a ship lost her top-gallant masts in a heavy squall.

Clouds.—"Cir. from N.E., wind S.E." is now a very common entry;

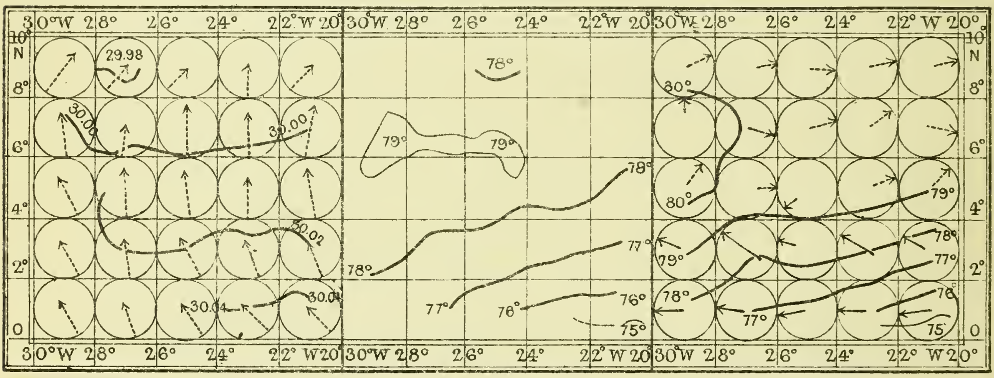
* These squalls were experienced by the same ship on the same day (June 9th).

JULY.

ISOBARS FOR EACH ·02 OF AN INCH, AND PREVAILING WINDS.* +	ISOTHERMS OF AIR FOR EACH DEGREE FAHRENHEIT.	ISOTHERMS OF SEA FOR EACH DEGREE FAHT AND PREVAILING CURRENTS.+ ‡



AUGUST.



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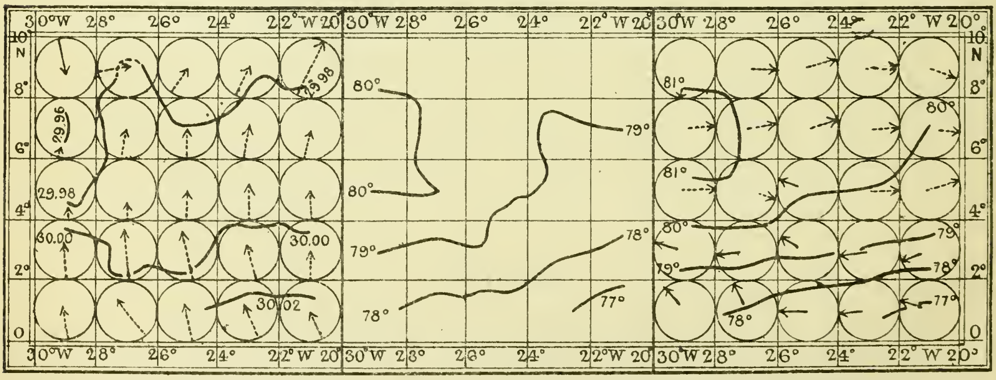


NOTE *When the Isobars or Isotherms are deduced from the data of 1° squares they are represented by a faint continuous line. Broken lines merely connect the different parts of an Isobar or Isotherm when the data does not authorize its being drawn.*

* *Each arrow flies with the most frequent wind of its square. Its length shows the mean force up to 5 of Beaufort's scale, and is proportional to the rate per hour at which the wind would drive Beaufort's Ship Nine miles an hour (force 5) extending across the circle.*

\+ *Northerly winds and Westerly currents have continuous whilst Southerly winds and Easterly currents have dotted arrows.*

‡ *The length of the current arrows is proportional to the rate in 24 hours 50 miles extending across the circle.*

J. Jobbins

whereas during the northern winter "Cir. from S.E., wind N.E." was a frequent remark.

Currents.—The remarks on currents show that much easterly current was experienced between 4° and 7° N. Also that the westerly current is frequently very strong near the Equator; from 0° to 3° N. it *averages* nearly 30′ in the 24 hours.

Natural History.—A beautiful ringdove was seen between 4° and 5° N. Dragon-flies, butterflies, and a cloud of insects called "Mosquito Hawks," between 6° and 7° N., and a swallow between 7° and 8° N. Locusts and butterflies between 9° and 10° N.

These seem to have been brought off the land by the tornadoes which blow from the eastward during the commencement of the rains.

Best route across the Equator.—In square 39, the strongest winds are still in the western half of the square, especially to the southward of 16° N.; on the eastern side of the square there is much light north-westerly wind between 16° and 18° N.

Considering the strong westerly current near the Equator, and that southerly winds extend so very far north, we are not inclined to recommend a westerly crossing to outward bounders in June, especially when we consider that the wind is frequently very far south near the American land in this month. Outward-bounders should stand boldly to the eastward with the southerly wind and easterly current, crossing the Equator well to the eastward. Homeward-bounders would probably do best by crossing the parallel of 6° N. in about 26° W.

July.

Isobars and Wind Arrows.—The isobars show a decided increase of pressure since June, and the barometer is at its highest point for the year. The mean for the square is 30·023. The highest, 30·069, is in its south-eastern 1° sub-square, whilst the lowest, 29·982, is in its north-western corner.

The increase of pressure is irregularly distributed, for whilst it averages more than ·04 in the southern half of the square, it does not average ·01 between 7° and 10° N. Where the pressure has increased so rapidly, the temperature of sea and air has decreased nearly 2° Fahr.

Plain wind arrows have disappeared from the square, and southerly winds prevail, though it will be noticed that they are very weak in the north-western corner of the square where the N.E. wind was prevailing in June, and where it always blew with so much more force than in other parts of the square.

Isotherms of Sea and Air.—The isotherms of sea and air have taken a very decided shape. They advance at the rate of about 1° Fahr. for each degree of latitude into the south-eastern corner of the square, until they come to 4° N., where they suddenly stop, and those for 79° of air, and 80° of sea, range round an area on the western side of the square.

Current Arrows.—The plain current arrows show that there is a very strong westerly current from 0° to 4° N., between 1° and 2° N., 63 per

cent. of all currents are north-westerly, at an *average* speed of 40′ in the 24 hours!

To the northward of 4° N. the dotted current arrows show that there is a prevailing easterly current, and we have already remarked that in latitude 4° N., which is along the line of contact between easterly and westerly currents, the change of temperature in air and sea ceases.

To the northward of 4° N., where the prevailing current changes from W. to E., the prevailing south-easterly wind becomes more southerly, and to the northward of 6° it is S.

Remarks.

Wind.—The southerly wind frequently blows with a force of 7 in various parts of the square.

Between 7° and 8° N. there was a very heavy squall from N.N.E. force 9.

Between 8° and 10° N. there are three entries of wind S.W. 8, also hard puffs from S.W., with constant heavy rain.

Between 8° and 10° N., the southern limit of the N.E. trade was met with five times, all in the early part of the month, and nearly all on the western side of the square.

Weather.—Mist is now most common over the cold water in the southern part of the square.

Clouds.—Upper clouds are still frequently from N.E. whilst the wind is S.E., there are also some cases even in the southern part of the square when the upper clouds were from the south-westward, when the wind was south-easterly.

Currents.—Between 4° and 5° N. are the following remarks:—"Sea very rough and turbulent." "Sea breaking like boiling water." "Ship on the edge of two currents, one going E. the other N.W."

Natural History.—The only allusion to creatures from the land was between 5° and 6° N. "Land birds, like hawks, flying to the north-eastward." As land birds are generally most ready to settle on ships, it is probable that those were sea birds; if so, there were none seen during July.

Sperm and other whales, grampuses, and black fish were seen. Between 8° and 9° N. we have "water covered with porpoises and bottle-noses, lying perfectly still." So perhaps they like the easterly current. Fish and sea birds were abundant. Stormy petrels were abundant to the southward, but not mentioned to the northward of 6° N. So perhaps they find suitable food in the cool westerly current.

Best Route across the Equator.—The western half of square 39 has the strongest winds, whilst they are strongest in the eastern half of SQUARE 3. Off Cape St. Roque there is a good deal of southerly wind in July. Considering the large amount of south-easterly wind and very strong westerly current to the southward of 4° N. in SQUARE 3, it seems right that outward bounders should be well to the eastward, say in 20° W. or probably several degrees further to the *eastward*, before going to the southward of 6° N., for in July ships bound to the

southward should not cross the equator to the westward of 25° W., on account of the southerly winds near St. Roque.

Good outward passages have been made in July, by passing to the eastward of the Cape Verde Islands.

Homeward bounders will do well to pass the parallel of 10° N. in 25° W.

August.

Isobars and Wind Arrows.—The isobars show a decided decrease in pressure since July.

The decrease of pressure has been slightly more, whilst the decrease of temperature has been less, in the northern than in the southern half of the square.

All prevailing winds are still southerly, and they have generally freshened since July, especially between 4° and 8° N.; from 8° to 10° N., the winds are more south-westerly than in July. The gradual curve in the direction of the prevailing wind as it passes from S. to N. is very marked.

Isotherms of Air and Sea.—The isotherms of air and sea are very similar to those of July, they have all advanced about a degree further to the northward, causing a slight fall in the mean temperature of the square; no doubt the result of the influx of cooler air and water from the southward, which has not yet been checked by the sun's southern progress.

The coldest air and sea (74°·4) experienced in the southern part of the square, shows in its south-eastern corner in August.

Current Arrows.—The currents of August are very similar to those of July, there is however a decided decrease in the force of the westerly current near the equator. We have the same sudden check in the change of temperature as in July, only it takes place about 1° further N., and we find by consulting the charts of 1° sub-squares that the prevailing westerly current does lie a little further N. in August than in July.

Remarks.

Wind.—Between 5° and 6° N., about 5 per cent. of the winds were force 7 from the southward. Between 6° and 10° N., about 2 per cent. of the winds were force 7 from the south-westward. Between 9° and 10° N., three south-westerly winds had a force of 8 and one of 9.

Weather.—There was very little thunder or lightning. Mist and dew were much more abundant over the cold water near the Equator than elsewhere.

Clouds.—Clouds were still frequent from the N.E. whilst the wind was S.E., though there is also great confusion in their motion at times.

Currents.—Ripplings are very general throughout the square.

Natural History.—No mention is made of seeing any land bird or insect in August. Whales were seen twice, one small one between the equator and 1° N. was going to the south-westward. Between

1° and 2° N., there was a shoal of grampuses going to the southward, where also many black fish were once seen.

Between 0° and 1° N., four strange looking fish were seen swimming about a ship for some time, they were red, had their fins on their heads, were about $2\frac{1}{2}$ feet long and a foot broad.*

Various.—There were 27 entries of falling stars, of these 7 were in 1857, and 6 in 1860.

Best Route across the Equator.—In square 39 the western half has the strongest north-easterly and south-easterly winds, whilst the eastern half has the strongest and most abundant north-westerly and south-westerly winds. Square 3 has very little difference in direction and force of wind depending on longitude. Near Cape St. Roque the winds are still unfavourable.

It would seem well for the outward bounder to come to the southward on the western side of the Cape Verde Islands, and to stand boldly to the south-eastward with the south-westerly winds which will be first met with, bearing in mind that to the southward of 5° N., the wind will draw south-easterly, and the current strong to the westward, so that it would be well to be to the eastward of 20° W. before crossing the parallel of 5° N. Homeward bounders would do well to go to the northward in about 25° W., or even further W., as the winds in the western half of square 39 are stronger and more easterly than those in the eastern.

September.

Isobars and Wind Arrows.—The isobars show a decided decrease of nearly ·02 in the pressure since August. The decrease of pressure seems to be very evenly distributed throughout the square. It has been greatest between 3° and 5° N.

There is only one plain northerly wind arrow, which is in the N.W. corner of the square, and it will be seen that a plain current arrow shows in the same 2° square.

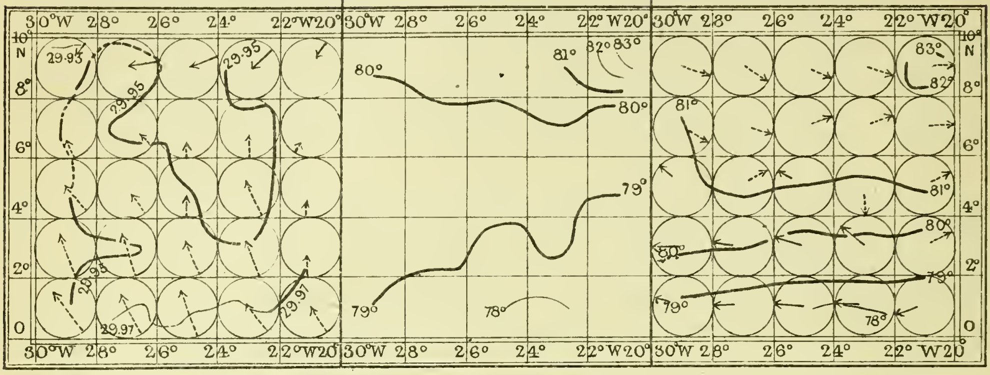
The dotted southerly wind arrows are very similar in direction to those of August, changing gradually from S.E. in the southern to S.W. in the northern part of the square; but they have very decidedly lost in force to the northward of 4° N., especially on the western side of the square, where, it will be remembered, the N.E. trade comes in with the greatest force.

Isotherms of Air and Sea.—The isotherms of air and sea show that the temperature has increased nearly a degree since August. It will be remembered that, in August, temperature had decreased, but now, the southern progress of the sun has checked the influx of cold brought in by the southerly winds, and the isotherms are, as it were, backing to the south-eastward, each one being about a degree further to the southward than it was in August. The stronger southerly winds on the eastern side of the square lift the eastern ends of the

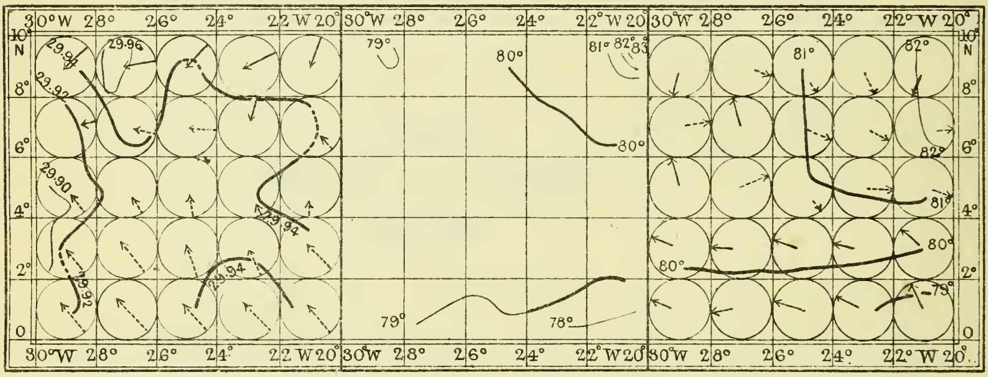
* This remark is from the log of the ship "Ingleborough" of Liverpool, Captain James Robert Rea, which was kept by the mate, W. H. Tiverton. Dated Friday, August 17th, 1855.

OCTOBER.

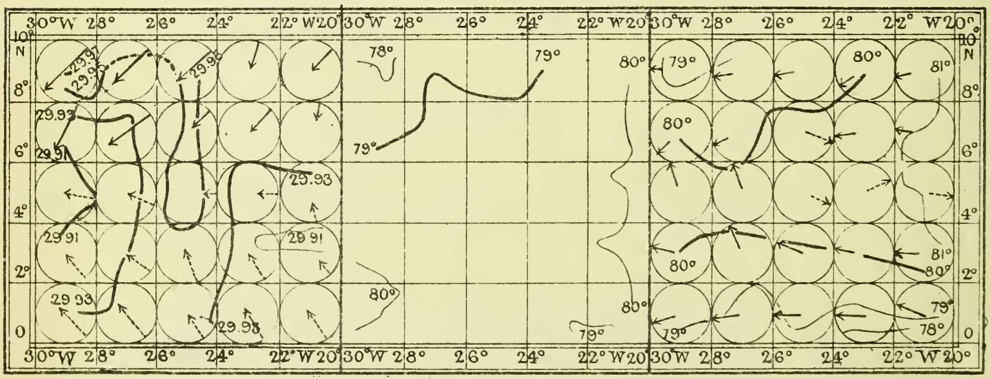
ISOBARS FOR EACH ·02 OF AN INCH. AND PREVAILING WINDS.※ †	ISOTHERMS OF AIR FOR EACH DEGREE FAHRENHEIT.	ISOTHERMS OF SEA FOR EACH DEGREE FAHT. AND PREVAILING CURRENTS † ‡



NOVEMBER.



DECEMBER.



NOTE *When the Isobars or Isotherms are deduced from the data of 1° squares they are represented by a faint continuous line. Broken lines merely connect the different parts of an Isobar or Isotherm when the data does not authorize its being drawn.*

※ *Each arrow flies with the most frequent wind of its square. Its length shows the mean force up to 5 of Beaufort's scale, and is proportional to the rate per hour at which the wind would drive Beaufort's Ship. Nine miles an hour (force 5) extending across the circle.*

† *Northerly winds and Westerly currents have continuous, whilst Southerly winds and Easterly currents have dotted arrows.*

‡ *The length of the current arrows is proportional to the rate in 24 hours 50 miles extending across the circle.*

J. Jobbins

isobars to the northward, just as the stronger northerly winds of March drooped their western ends to the southward.

Current Arrows.—The currents of September are very similar to those of August, the prevailing westerly current near the equator, has again lost somewhat in force. The easterly current is not so northerly as it was in August. The increase in sea and air temperature again progresses from the S.E. to the N.W., stopping after passing into the easterly current.

Remarks.

Wind.—Between the equator and 4° N. there were several south-easterly winds, having a force of 7.

Between 5° and 6° N. there was the largest percentage of winds force 7, they were chiefly from the south-westward.

Between 8° and 9° N. there was a N.E. squall; force 6; and a heavy easterly squall.

Between 9° and 10° N. south-westerly winds, force 7, were frequent, and sometimes with heavy gusts. There were also squalls from the same quarter, and a heavy northerly squall.

Between 8° and 9° N. the N.E. trade was twice experienced, about the 28th of the month.

Weather.—Coming from the southward, lightning was first seen between 4° and 5° N., where the easterly and westerly currents of water meet.

Clouds.—Upper clouds were most frequently seen coming from the north-eastward.

Natural History.—Between 4° and 5° N. a bird was seen, with a bill like a snipe and feathered like a plover.

Between 7° and 8° N. a martin, a swallow, and a hawk were seen.

Between 9° and 10° N. swallows and two other small land birds, butterflies and dragon flies, were seen.

Here we see that land birds and insects show themselves again in the northern part of the square, where the north-easterly wind shows itself towards the end of the month. They are probably brought off the land by the tornadoes.

No whales, grampuses, or black-fish were seen; porpoises were frequent, between 8° and 9° N.

Various.—" 4 A.M., between 8° and 9° N., passed through a strip of water, as white as snow, stretching E. and W. as far as could be seen, and about 20 yards broad; the rest of the sea very dark, and not at all luminous."

Best Route across the Equator.—In square 39, the strongest winds are on the western side of the square, so that it seems best for the *outward bounder* to come to the southward on the western side of the Cape Verdes, and to stand boldly to the south-eastward when he gets the southerly winds and easterly current, tacking to the south-westward as the wind draws south-easterly, always remembering that there is a strong westerly current to the southward of 4° N. The wind is still very southerly near the land in the neighbourhood of Cape St. Roque, so that ships should not aim to cross the line far to the westward.

Homeward bounders would do well to go to the northward in about 25° W., or, at any rate, to be as far W. as 25° W. when in 10° N.

October.

Isobars and Wind Arrows.—The isobars of October show that there has been a general decrease of about ·04 in the pressure since September. This is the greatest decrease for any month in the year. On analyzing it, we find that it amounts to nearly ·06 between 0° and 3° N., whilst it is not quite ·03 between 7° and 10° N., indicating how the southern progress of the N.E. trade has checked the decrease in the north.

The plain wind arrows show that the N.E. trade appears in the northern part of the square, though it is very light and easterly.

The dotted wind arrows show that the southerly wind has retreated 2° to the southward, and decreased in force since September.

Isotherms of Air and Sea.—The isotherms of air and sea show that both have increased in temperature nearly 1° Fahr., since September. In both cases the increase has been greatest in the southern part of the square, where the air and water are coming in after having been under the influence of a vertical sun. The north-eastern corner of the square is an exception; it seems to be specially heated by the influx of easterly wind from Africa.

Current Arrows.—The plain current arrows show that westerly currents still prevail in the southern part of the square, and extend a little further N. than they did in September, but their speed is not so great.

The dotted arrows indicate that easterly currents still prevail in the northern part of the square, but their speed is not so great; hence we find that both winds and currents have become weaker since September.

Remarks.

Wind.—Between the equator and 6° N. there were several entries of wind from S.E; force 7.

Between 6° and 10° N. there were several severe squalls, but scarcely any steady winds of a force of 7. There were many severe north-easterly squalls, some extending as far S. as 4° N.

Between 1° and 2° N. there was a tremendous squall, lasting half-an-hour, with extremely heavy rain for 3 hours.

The N.E. trade is remarked on as being once met with between 6° and 7° N.; five times between 8° and 9° N.; and three times between 9° and 10° N.

Between 9° and 10° N., on the 19th, 1864, a very heavy gale, force 10, was experienced. The Captain says, "I never felt such a determined force of wind, lasting so long, about this latitude. It blew hardest from S. and S.W., lasting 3½ hours." This gale may have been related to a West India hurricane.

Weather.—Lightning was again first seen at the meeting of the two currents of water. From 3° to 8° N. it was most frequently seen to the northward, and from 8° to 10° N. to the southward.

Clouds.—Upper clouds were most frequently seen moving from the

south-eastward, though there was still a large percentage from the north-eastward.

Natural History.—Swallows accompanied ships as far S. as between 3° and 4° N. They abounded between 6° and 10° N., as well as other land birds and insects. The following entry gives an idea of their number :—" Between 9° and 10° N. an owl, say thirty martins, a few butterflies, and dragon flies about ; wind, E.N.E."

In the N.E. corner of the square is the following entry :—" Strong smell of land," although it is 250 miles off. In the same part, the temperature of the air has gone up 2°·7 since September, and it is remarkably dry, so that, at this great distance, we find several evidences of the tornadoes which blow from the land in this month.

Whales were seen between 2° and 3° N., and several between 6° and 8° N. ; all the latter moving to the northward.

The sea abounded with jelly fish, &c., from the equator to 6° N. Stormy petrels were very abundant between 5° and 7° N.

Various.—Falling stars were noted 23 times. They were very abundant in 1859 and 1866.

An earthquake was experienced, near St. Paul's Rocks, at 11·30 p.m., 19th, 1859. It lasted about 3 seconds. The ship felt as if grating over rocks ; the helmsman felt the wheel shake in his hand. The captain was on deck at the time and can vouch for the truth of the statement. We have already remarked on one in the same place, in January of the same year.

Best Route across the Equator.—Square 39 has decidedly stronger winds in the western than in the eastern half of the square.

Square 3 has lighter winds on the eastern than on the western side of the square, and the currents are not so strong as in September.

Square 303 has a prevailing S.E. by E. wind, with sometimes a spirt of north-easterly wind near the land.

Hence it seems well for the outward bounder to pass to the westward of the Cape Verde Islands, and to stand boldly to the south-eastward, with the southerly wind and easterly current, until the wind will allow of a fair amount of southing on the port tack, when she may stand boldly to the south-westward, and, if necessary, cross the equator as far west as 28° W.

Homeward bounders should go to the northward on the western side of the square.

November.

Isobars and Wind Arrows.—The isobars of November show that there has been an average decrease of about ·02 in the pressure since October, but we find that it is chiefly in the southern part of the square ; for instance, between 9° and 10° N. it has not changed, whilst between 0° and 1° N. it has decreased nearly ·04. Here, as in October, we have the effect of the N.E. trade pressing to the southward in the northern part of the square. For the first time since May the highest pressure is in the northern part of the square. The isobars are also crowded in the north-western corner of the square.

The plain wind arrows show that the N.E. trade has become more frequent in the northern part of the square, where it has also gained in strength. It is still very easterly, which contrasts remarkably with its direction from February to May, when it is very northerly, especially on the eastern side of the square.

The dotted wind arrows show that the S.E. trade has retreated and lost in force, especially between 3° and 5° N., as shown by the chart of 1° sub-squares.

Isotherms of Air and Sea.—The isotherms of air and sea still run in similar directions, and the sea keeps nearly 1° warmer than the air. Both continue to show the highest temperature in the north-eastern corner of the square. This is a singular case of the wind blowing from greater heat towards greater cold; it is accompanied by a great difference between dry and damp bulbs, as also by the appearance of insects. The heat in the N.E. corner of SQUARE 3 is increased by the easterly current still prevailing there. In December it is driven further south by the influx of a westerly current.

Current Arrows.—The plain current arrows indicate that a westerly current is again showing in the northern part of the square, whilst it still prevails up to 4° N., though not quite so strong as in October.

The dotted current arrows show that easterly currents still prevail from 4° to 10° N., but that they are not so strong as in October. It will be noticed that in the north-eastern part of the square the prevailing current is more to the southward of E. than it had been in previous months, as if it began to feel the influence of the freshening northerly wind.

Remarks.

Wind.—Between the Equator and 6° N. there are still several entries of south-easterly wind having a force of 7: whilst from 7° to 10° N. those from N.E. are most frequent. Of the seventeen entries, five were south-easterly and twelve north-easterly. Between 9° and 10° N. very heavy squalls were experienced.

Between 8° and 9° N. we find "Wind variable, sometimes very hot, at others very cold." This is interesting in connection with the high temperature in the north-eastern corner of the square.

Weather.—Lightning has greatly increased since October, it is most frequently seen in the northern part of the square; from 5° to 8° N. it is chiefly seen on some northerly bearing, but from 8° to 10° N. on some southerly bearing. It was most abundant and awful between 6° and 8° N., with stifling weather.

Clouds.—Upper clouds from the north-eastward have greatly decreased since October, whilst those from the south-westward have increased. Those from the south-eastward still greatly preponderate.

Natural History.—An owl, a teal, and some swallows were seen between 3° and 4° N., between 4° and 6° N. there were several land birds. Some captains remark that they had followed their ships from the northward. Between 6° and 8° N. butterflies and a moth were seen, as well as land birds.

Whales, blackfish, and porpoises, as well as fish, birds, and

medusæ, abounded between 4° and 6° N., which looks as if the verge of the two currents was favourable to animal life.

Various.—Falling stars.—There are thirty-six entries of falling stars, the most abundant seem to have been between the 9th and 10th, 1855, and after midnight of the 14th, 1869.

Best route across the Equator.—Square 39 has decidedly stronger winds on its western than on its eastern side, especially between 14° and 16° N., for in the eastern half of that zone we find 17 per cent. of calms against none in the western half.

SQUARE 3 has the lightest winds in its eastern half.

Square 303 has a good deal of north-easterly wind near the South American coast in November, so that it seems safe to stand boldly to the southward, after passing to the westward of the Cape Verdes, and on getting the southerly wind, to take the tack which gives the most southing.

DECEMBER.

Isobars and Wind Arrows.—The isobars of December resemble those of November. There is scarcely any change in the mean pressure of the whole square since November, for there has been an increase in its northern and decrease in its southern half. The greatest increase is in the north-western corner of the square, and the greatest decrease in the south-eastern, so that now the highest pressure is very decidedly in the northern part of the square. The isobars are closest in the north-western corner of the square where the N.E. wind is strongest.

The plain wind arrows show that the N.E. trade has worked its way down to 6° N., and increased in force, especially in the north-western corner of the square.

The dotted wind arrows show that the prevailing wind is nearly E. between 4° and 6° N., in which zone the two trades seem to meet and combine to form a stronger wind than that which prevailed in November.

Isotherms of Air and Sea.—Here we find a lower temperature coming into the north-western part of the square where the N.E. trade is so fresh; in the case of the air the lowest temperature of the square is there. The south-westerly trend of the isotherms in the northern part of the square, and the north-westerly trend of those in the southern, indicate that they are the result of the two trades, and inclining to the southward or northward with their strongest winds. The hottest air and water now show on the eastern side, instead of in the north-eastern corner, of the square.

Current Arrows.—The plain current arrows indicate that where the N.E. trade has increased, a westerly current has set in, which inclines to the southward.

The equatorial westerly current, which is a constant result of the S.E. trade, has increased in force and inclines to the northward, especially on the western side of the square.

The dotted current arrows show that the easterly current has reduced very much in amount since November, but that it still exists on the

eastern side of the square where the sea is hottest; it inclines to the southward.

Remarks.

Wind.—We have twelve entries of steady winds amounting to force 7. Of these four were south-easterly, two easterly, and six north-easterly.

Squalls were not so abundant in December as in November: they were most frequent from the south-eastward and eastward.

Weather.—Lightning was most frequently seen to the northward between 1° and 6° N., whilst from 7° to 9° N. it was much the most frequently seen to the southward.

Clouds.—There is a great increase in the percentage of upper clouds from the north-eastward, whilst that of others has decreased. This is not in accordance with the experience of November or January.

Natural History.—A small brown owl was caught between 3° and 4° N.

Four butterflies and a land bird were seen between 5° and 7° N.

Whales were seen between 3° and 4° N. Grampuses between 4° and 8° N.

Black fish between 1° and 9° N. Porpoises between 4° and 8° N.

Various.—Falling stars were reported sixteen times. The most numerous were on the 2nd, 1839; the 12th, 1855, very abundant; the 11th and 12th, 1857.

Brown dust was seen on the sails between 1° and 9° N.

Best Route across the Equator.—In square 39 there are decidedly stronger winds on the western than on the eastern side of the square. There are 15 per cent. of calms between 14° and 16° N. on the eastern side, whilst, in the same zone, there are none on the western. On the western side there is a large per centage of south-easterly or easterly winds, *especially in the northern part of the square*, where it amounts to 40 *per cent.*! This fact is supported by the remarks in December, which say that the N.E. trade has been more like the S.E.

In SQUARE 3 the winds on the western side are also very decidedly the strongest, whilst in square 303 nearly all winds are to the eastward of S.E., so that ships need not fear crossing the equator well to the westward.

CONCLUSION.

We have now given a slight history of a square of the sea, which, during the year, is twice traversed by a zone of high temperature and an accompanying area of low pressure, into which opposing winds are drawn. The amount and direction of each wind seems to be very much modified by the temperature and position of its source. The temperature of course, to a great extent, depends on the declination of the sun; but the position of the source of each wind depends upon the relative positions of land and sea.

By consulting Buchan's isobaric lines* we see a picture of the areas

* "The Mean Pressure of the Atmosphere, and the Prevailing Winds, over the Globe, for the Months and for the Year." By Alexander Buchan, M.A., F.R.S.E. "Transactions of the Royal Society," Edinburgh, vol. xxv.

of high pressure which lie on the polar sides of the trade winds. They are given on Diagram 1, and marked A and B. These areas are supposed to supply the air of the trade winds, and it will be seen that SQUARE 3 has the southern one bearing to the south-eastward, so that it gets the full force of the S.E. trade, never entirely losing the prevailing south-easterly wind and westerly current caused by that wind, but the northern area of high pressure is to the northward, or rather north-westward, of SQUARE 3, whilst the coast of Africa is very near the north-eastern corner of the square, so that a large part of its area is, as it were, under the lee of Africa, and the full swing of the N.E. trade is only felt in its north-western corner. This is beautifully shown by the direction and relative length of the arrows of prevailing wind from December to June. This opinion is fully borne out by the fact that the north-eastern coast of South America, which is to the south-westward of the northern area of high pressure, gets a N.E. wind as far down as 3°, or even 4° S. during the strength of the N.E. trade, when SQUARE 3 has a S.E. wind up to 2° N.; hence we find that the sun creates a low pressure in the doldrum, and the area of high pressure in either hemisphere which is most convenient and has not heated land in the way, supplies its demand.

The northern part of SQUARE 3 only gets prevailing easterly winds during the short time when the pressure over the neighbouring African land seems to be greater than that over the sea to the westward and south-westward of it. It will be remembered that October, when the easterly wind sets in, is one of the hottest months of the year in SQUARE 3, and that since September there has been the greatest monthly fall in the barometer, especially in the southern part of the square, which may account for the sudden in-rush of hot air, birds, and insects from the land into the north-eastern corner of the square, where the land is even smelt, though more than 250 miles off!

I will now by your permission say a few words on certain facts which have struck me whilst working at the data of SQUARE 3.

1st. We find that during the northern winter and spring, when the N.E. trade is pressing its way to the southward as a body of cold air, more upper clouds are seen to be moving to the northward, whilst during the southern cold season, when the southerly wind is pressing its way to the northward, and crosses the Equator as a mass of comparatively cold air, more upper cloud is seen to be moving to the southward.

This looks as if the air which rises in the doldrums had freer egress towards that pole which is experiencing winter. If this be the case, which we shall be better able to decide after all the remarks for SQUARE 3 have been systematically worked up, it seems clear that any cause, such as a remarkable increase of temperature in one hemisphere, or decrease in the other, which tends to give freer course in a certain direction to the upper current, and thereby to increase the amount of air in that area of high pressure which lies on the polar side of a trade wind, will most probably increase the force of the various winds flowing from it. For instance, if during last winter any cause existed which threw a larger body of air than usual into

this upper current travelling northward from the doldrum, then we might expect to find a higher pressure than usual in about 30° N., where this upper current seems to settle down, and stronger westerly winds to the northward of that latitude. For the higher the pressure near the Azores, in comparison with the low pressure which prevails over the Atlantic to the northward of them, the stronger will be the westerly winds between these two pressures. This supports the idea which I have heard expressed by Captain Evans, that we may have to look to the doldrums for the causes of our weather changes.

2ndly. We find that the highest pressure in SQUARE 3 takes place in July, and it is after this time that the West India hurricanes commence, hence, just as two people are needed to make a quarrel (or two high tempers), so are two high pressures required to form a hurricane. Here we have a high pressure on the southern side of the doldrum, and we know that there is always one to the northward of it; we also know that the southern progress of the sun in July is drawing with it the doldrum, or zone of lowest pressure, and the prevailing winds on each side of it, so that where southerly winds have been, northerly winds are coming, and it seems to be the collision between those winds which gives the first start to the West India hurricanes. The large amount of heat and moisture in the air, at this season, is no doubt a great additional reason for them. It seems worthy of remark that lines drawn to the north-westward and south-westward from the areas of high pressure, A and B, which supply the air for the two trades, would cross in about that part of the sea where the West India hurricanes are bred. See such lines on diagram 1.

In paper, No. 13, published by the Meteorological Office, we have shown that the winter snow storms on the East Coast of America have a similar cause to the one given above for the West India hurricanes, viz., a high barometer over the American land, and another over the sea to the northward of the N.E. trade, with a lower barometer and warm moist air over the Gulf Stream which runs between the two high pressures just named. Mr. Meldrum finds that the Mauritius hurricanes arise from a like disposition of pressure.

3rdly. In SQUARE 3 there seems to be a much smaller difference of pressure to a given distance for a given amount of wind than there is over the British Islands. For instance, our diagrams seldom show more than a difference of ·01 inch to 50 miles, with an average wind force of 3 or 4 of Beaufort's scale, whilst such a difference would be an indication of much less wind in England.

4thly. It will be seen that although the trade winds which produce the westerly currents of water are chiefly north-easterly and south-easterly, the currents themselves are chiefly westerly. Now it is known that the air composing the trades which meet in the doldrums, rises, and passes away as an upper current, but the water which they drive before them, as well as that which falls so abundantly in the doldrums as rain, cannot rise like the air, excepting the very small quantity lifted by evaporation in this cloudy rainy part, so that it must be heaped and form a ridge of water in the doldrums, which ridge would naturally divert the water flowing towards it into a more

westerly direction than that of the air which drove it. From this ridge the easterly current, so frequently mentioned in this paper, seems to run as a back-drift, when the pressure of a following wind ceases. The outline of the Coast of Africa, considered in connection with the north-westerly current caused by the S.E. trade, accounts for the back-drift into the Gulf of Guinea; for the tendency of the above named current is to draw water out of the Gulf, just as blowing at right angles across the mouth of a tube full of liquid draws it out, the result being that the water in the Gulf is at a lower level than that to the westward of it, where the tendency of the two trades is to heap water; consequently, as soon as the two currents meet in the calm of the doldrums, the water is free to act under the influence of gravitation only, and flows to the eastward into the Gulf of Guinea.*

In the last place let me call your attention again to the remarkable way in which the temperature of the sea continues about 1° Fahr. warmer than that of the air, a similar difference was noticed when working at the meteorology of the West Coast of South America. (See p. 17 of Official, No. 11, published by the Meteorological Office.)

I have now given you a hurried sketch of the work which is in hand in the Marine Department of the Meteorological Office; this work will, it is hoped, be as useful to the scientific man as to the navigator. The Committee of the Royal Society who manage the Meteorological Office, propose to publish monthly charts similar to the one now exhibited, which are to be accompanied by important extracts from logs relating to wind, weather, clouds, natural history, and physical phenomena of any kind.

May I be permitted to add that the way in which we find one class of observation supporting the evidence of another, seems to be an argument in favour of working up the various data together, instead of dividing them amongst different nations. For instance, in the north-eastern corner of SQUARE 3, in October, we have a great increase in the temperature of the air and sea, as well as in the dryness of the air; there is also a large number of land birds and insects, and a strong smell of land, all of which come with a prevailing easterly wind. These facts are, to a certain extent, related, and would lose force by being separated. The same remark is especially applicable to the sudden stop in the change of temperature of both air and sea, as we pass from the westerly to the easterly current of water in July, and other months.

I have found it difficult to convey a general idea of the work in so short a time, and beg to thank you for your kind attention.

* It seems quite clear that if the N.E. and S.E. trades draw the sea away from Africa, and if other water cannot come from the westward, there must somewhere be a back-drift to the eastward.

The large amount of current ripplings in SQUARE 3 seems to be caused by this diverting of the currents out of the directions in which the winds would drive them, if the drifts of the two trades did not meet and heap the water.

LECTURE.

Friday, March 28.

Major-General J. T. BOILEAU, R.E., F.R.S., in the Chair.

RIFLES AND RIFLING.

By Captain J. B. O'Hea, late 25th King's Own Borderers.

The Chairman: Allow me to introduce to you my friend, Captain O'Hea. He is no novice in matters connected with rifles, and I have no doubt that he will give us both a very interesting and a very instructive lecture.

Captain O'Hea: After the years occupied by the late Special Sub-Committee in experiments with the object of obtaining for the nation the best military small-arm, and the elaborate Reports published on results of trials conducted under their superintendence, a paper on rifled arms may appear almost superfluous. However, esteeming a request from the Council of this Institution not only an honour but, to a certain extent, a command; and further, bearing in mind that nearly three years have gone by since the publication of the reports of the Special Committee—three years remarkable for improvements in breech-loading rifles (about sixty patents having been applied for during that time), and for the occurrence of a great continental war which afforded, I may say, the first practical test of the system; I have much pleasure in giving here, the information which I have derived from trials with various descriptions of this class of weapon.

In explanation of the title of my paper, "Rifles and Rifling," it may be well briefly to refer to the origin of the word and the weapon,—to define what a rifle really is, and what is meant by rifling.

With regard to the derivation of the word *rifle*, opinions vary much. It is stated by some, that the name comes from the Teut. word *Rijffelin*, a kind of whetstone with finely fluted surface (in the early rifles, the bore was channelled or fluted); others assert that it comes from the Danish word *riffel*, a chamber or groove; again it is said to be derived from an Anglo-Saxon word signifying to *rive* or *tear*, this last derivation having reference no doubt to the manner of forming the rifling. This difference of opinion clearly indicates the absence of definite knowledge of the origin of the word.

About the date and place of the origin of rifling, opinions are nearly

as conflicting. Notwithstanding the many statements hazarded on this point,—namely, that the rifle was invented at Vienna, in 1498; at Nuremberg, in 1520; in Denmark, in 1545,—I would, without any desire to be sceptical, remark that the origin and date of grooving or rifling barrels, like those of the invention of portable fire-arms, are, and must remain, matter of speculation. And I would venture merely to suggest, that the origin of straight rifling might, not without reason, be traced to the primitive mode of forming a polygonal bore, as in the earlier iron guns, by placing bars of iron together longitudinally, and binding them over. Some of these old arms are still to be found. From the specimens in existence, one thing appears pretty certain,—that, in Europe, rifling was first adopted as a means of facilitating loading from the muzzle, and the fluted grooves or lines (which, like the *Rijffelin*, were straight), were simply intended as channels to drain off the fouling of previous discharges, and thus render loading less difficult.* The gunmaker of Nuremberg who has the doubtful credit of having been the first to cut these channels on a curve, is supposed to have done so by accident. I would observe that Dryden, in the fifth act, first scene, of his well-known play "Marriage-à-la-Mode," written prior to 1673, makes allusion to the rifle as a "delicate screwed gun"; and in 1672, P. Daniel, in his "Histoire de la Milice Française," refers to the invention as old. Be all this as it may, until Robins published his tract on "Rifled-barrel Pieces" in 1747, there is no trustworthy evidence to show that the real effect of spiral rifling on the flight of projectiles propelled by gunpowder, was understood.

I have no desire to inflict on this assembly a further or more detailed history of the rifle. I shall content myself with defining what the modern rifle is, its object, and results.

The word "rifle," in its general acceptation, means the arm complete; but, as most people know, the barrel gives the distinctive appellation.

A rifled barrel or tube is literally nothing more or less than a compound mechanical power, *i.e.*, a female screw—the nut through which a bolt (the projectile) is driven with more or less velocity, according to the power applied to it, and as the pitch and form of screw afford more or less facility for its transmission. This, whether the projectile be a perfect or imperfect sphere, a rifled cylinder for its whole length or only in part. In any case, the projectile becomes the male screw if, when passing through the bore or any part of it, its surface is made to conform in any way, or by any means, to the incline of rifling. Whether this conforming is effected by expansion at, or ramming down from, the muzzle, as in early rifles (and indeed in those used far into the present century); by expansion at the breech caused by ramming on a pillar on Colonel Thouvenin's plan, or by a cup or plug inserted at the base of the bullet; whether the projectile is made to conform to the

* A very similar pattern of rifling was manufactured in this country not many years ago—although for a different purpose. I allude to what was known as "scratched" rifling: this consisted in fluting or rifling shot barrels with straight lines along which the grains of shot were supposed to travel in passing up the bore, thus keeping the bulk of the charge well together It would be instructive to learn from some of the leading gun manufacturers what effect this system had on the birds.

pitch of rifling by means of a sabot, as in the Prussian gun, or by a jacket of leather, paper, or other material, or is compelled to follow the rifling by studs, grooves, ribs, &c. ;—in every case where the surface of the projectile is made to rotate in the bore round its axis of progression, the projectile is the male, and the barrel, being the means, is the female screw.

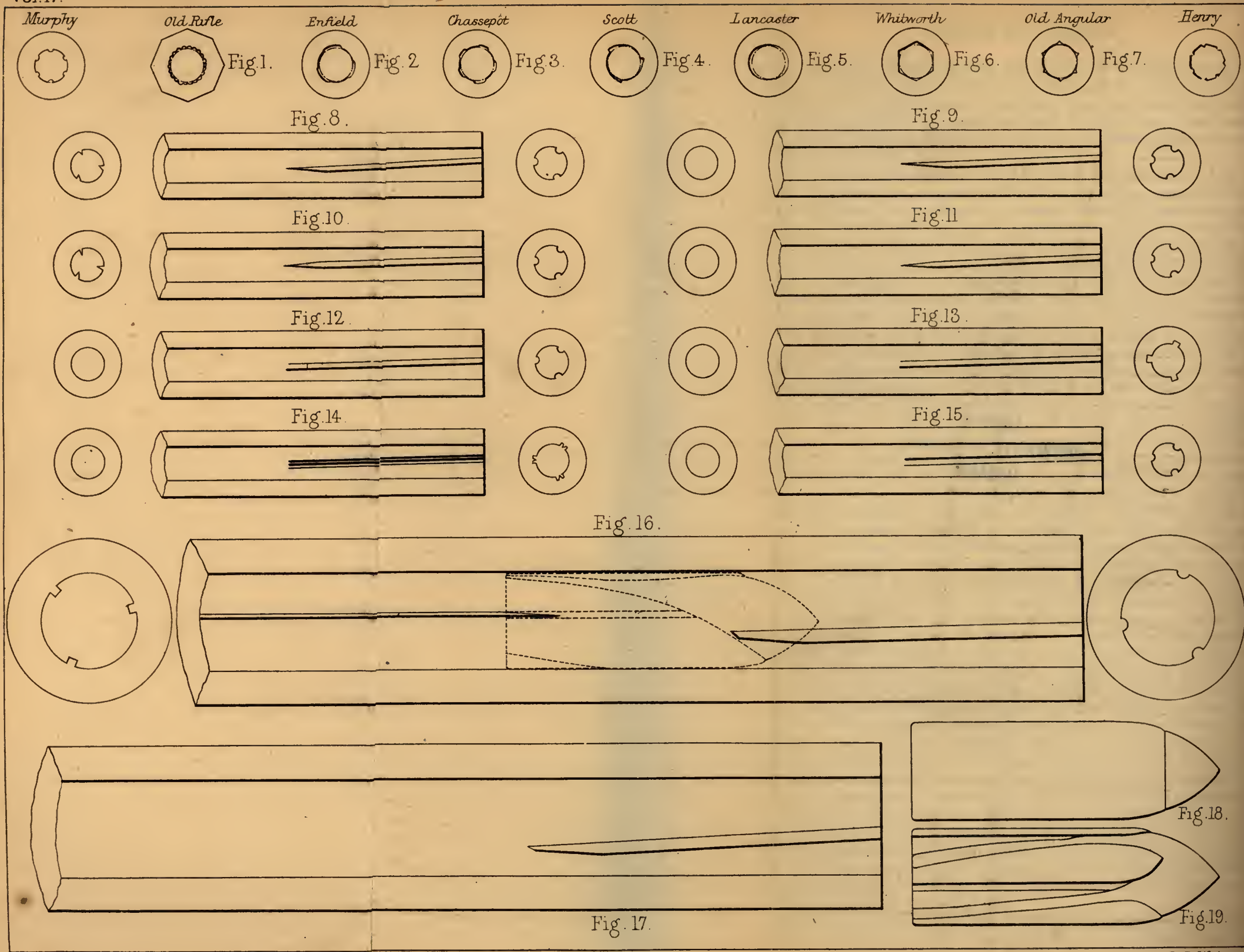
The power, however, used in the rifle is not like that of the lever with the screw. I would remark here, that this mechanical means, the rifle barrel, is used with a power essentially unmechanical, inasmuch as when once that power, gunpowder, is put in action, it is not under control. All ordinary powers used in mechanics are capable of being controlled; but gunpowder once ignited, is, of course, to a great extent, unmanageable. It appears strange that, up to the present time, beyond the slight variation obtained by difference in the size of grain or the position of point of ignition in the charge, but little practical effort has been made to control, even to a limited extent, the combustion of gunpowder in fire-arms, or to apply judiciously and gradually to projectiles—according to different weights, and to the resistance offered to initial motion—the power stored up in the charge.

The subject of rifling may be divided into the pattern, or quality, of screw used; the pitch, or power, of screw used; the manner of manufacturing or forming the screw; and lastly, the effect which each pattern of rifling and degree of pitch has on the projectile with reference to the power applied to it,—*i.e.*, on velocity and vertical accuracy, and on the arm itself with reference to recoil, and wear and tear.

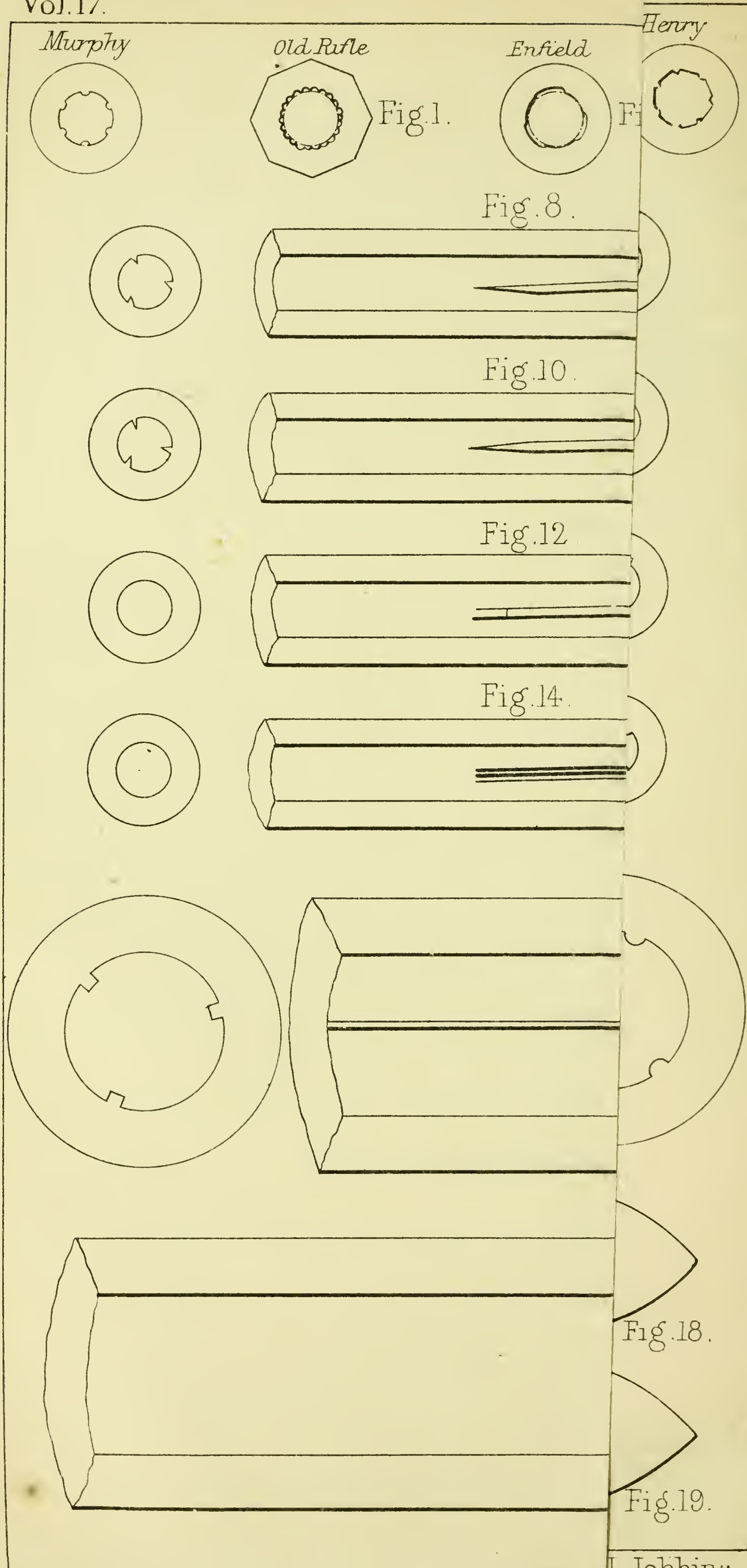
Benjamin Robins, in his tract on "Rifling," before alluded to, states that "the number of threads in each barrel are (*sic*) different according to the fancy of the workman, and the size of the barrel; and in like manner, the depth these channels or rifles are cut down to, is not regulated by any invariable rule, but differs according to the country where the work is performed or the caprice of the artificer." At the present time, the pattern of rifling appears to be as much a matter of fancy, as were the number of threads and the depth of the channels in the time of Robins. An inspection of the valuable collection of rifles in this Institution, will bear out this assertion.

Nevertheless, the pattern of rifling may be divided into three, or at most four, distinct classes, namely :—(1), the ordinary land and groove pattern, of which there are many modifications, some of which possess special merit; (2), the elliptical, known as the Lancaster, system, which, although stated by Greener and others to be a modification of the two-groove rifling, is nevertheless a distinct pattern, inasmuch as the barrel is throughout a smooth-bore rifle, if I may thus express myself; and (3), the polygonal, formerly known as the angular pattern of rifling, and now styled the Whitworth. All other patterns appear to me to be either modifications or compounds of the above,—not even excepting the well-known and popular Henry, now the recognized rifle-barrel of our service, and to be met with in the hands of the most distinguished shots in the kingdom.

There is yet another system of rifling barrels, patented within the last two years, viz., "part" rifling; but, as it is applicable to all or any


Murphy
Old Rifle
Fig. 1.
Enfield
Fig. 2
Chassepôt
Fig. 3.
Scott
Fig. 4.
Lancaster
Fig. 5.
Whitworth
Fig. 6.
Old Angular
Fig. 7.
Henry
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11
Fig. 12.
Fig. 13.
Fig. 14.
Fig. 15.
Fig. 16.
Fig. 17.
Fig. 18.
Fig. 19.

J. Jobbins


Murphy
Old Rifle
Enfield
Henry
Fig. 1.
Fi
Fig. 8.
Fig. 10.
Fig. 12.
Fig. 14.
Fig. 18.
Fig. 19.

J. Jobbins

pattern, I shall not describe it under this head. The system is altogether a novelty, as I shall explain presently.

Of the pattern I first named—the "land and groove"—I can say but little that you do not already know. It may not, however, be out of place to remark that the *angular* land and groove pattern, shown in Plate XXII, necessitates a large frictional area of resisting surface in the barrel and projectile:—the deeper and more angular the rifling, the larger the area of friction, which not only involves deformity of the surface of the bullet, but causes a certain unprofitable expenditure of powder, consequent on the increased frictional resistance. It is, therefore, obvious that the shallower and less angular rifling of this pattern is, the better: as, in addition to other advantages, the less will be the indentation of the surface of the bullet, the less then the alteration of the figure, and, as a consequence, the harder may be the material composing the bullet. I would name as examples of the severe land and groove pattern of rifling that known as Baker's rifle (see Plate, fig. 1), the original arm of our Rifle Brigade; of the finer kind, the Enfield (fig. 2), and the Chassepôt (fig. 3); and of the very finest pattern, the Metford, the high reputation of which affords the strongest proof of the value of fine rifling. The rib pattern is the land and groove in a different form; the land being narrow and, in some cases, shallow and non-angular, the groove wide. In this pattern, the narrower, shallower, and less angular the rib, the more efficient the rifling,—provided the projectile is composed of a material capable of being moulded to the shape of the bore. Another form of the rib pattern is what is termed segmental rifling, that is, the bore grooved in segments of a circle of much smaller circumference than that of the entire bore, the space or angle between the segments serving as a fine rib. This pattern approaches the fluted rifling used in early arms, the difference consisting only in the incline of rifling and the number of segments.

I would advert to ratchet rifling as another modification of the land and groove pattern, as it is a union of the angular rib and inclined plane (or segment). The most perfect modification of this form (fig. [illegible]), is the invention of Captain Scott, R.N.; it has considerable merit in small arms, but, as it appears to me, will prove of still more value in large guns. I believe this is the only pattern of rifling for ordnance which not only compels rotation of projectile round the axis of progression, but, by the very effort of forward motion, combined with rotation, forces the shot to centre itself in the bore:—the importance of this it is unnecessary for me to point out.

The elliptical, or Lancaster pattern (originally, I believe, American) (fig. [illegible]) necessitates a departure, not only from the rules that regulate the formation of the screw, but, to a certain extent, from strict mechanical principles; for not only is the bore smooth, but, in addition, the difference in the diameters across what, if more defined, would be called grooves and lands, is very slight, the difference between the major and the minor axis being ·005. Therefore, in order to prevent slipping of the projectile—which must be of soft metal—in its passage up the bore, it is necessary, not only that the pitch of rifling should

become quicker towards the muzzle, but that the bore should lessen somewhat in both diameters towards that point.

Although the practice of the Lancaster rifled small-arm in the hands of our Royal Engineers has given very high results, it appears to me that as the projectile has, while passing up the bore, to undergo a continual change of form, consequent on the increasing pitch of screw, the system cannot be considered, mechanically speaking, correct. Moreover, I believe I am not in error in stating that, in large guns rifled on the Lancaster system, an increasing spiral cannot be used. At the same time, while I feel compelled to remark that it is impossible to obtain even expansion from a barrel, the bore of which is an ellipse and the outer surface a circle, I feel bound, in justice to this pattern, to state that I have used a Lancaster double rifle with fair results, both with shot and bullet.

The polygonal, or Whitworth pattern, which is the old angular rifling in an improved form (see Plate, figs. 6, 7), is too well known to require description. The patentee, one of our greatest engineers, has gone far by his experiments to indicate the value of certain degrees of pitch and diameters of bore,—whether to decide the best pattern of rifling or not, is a matter on which opinions differ; and, above all, he has shown how an ancient pattern of rifling can, by proper manufacture and judicious management, be made to give exceptionally good results. But the Whitworth polygonal rifling is coarse, and when a cylindrical bullet is used, involves, as can be seen, considerable windage, which has to be provided against by wads or wrappings, &c.

The Reports of the Special Sub-Committee give an account of the Henry rifling which received the prize offered by the Secretary-of-State for War in 1868, for the best rifle. The rifling is polygonal, having a rib in each angle, which latter feature materially lessens the windage, thus securing an advantage over the simple polygonal pattern when a cylindro-conoidal bullet is used. (See Plate, fig. 7a.)

I would, however, mention two peculiarities connected with the Henry rifle barrel, of which the one may not be generally known—the other is inconveniently felt by those who use the Martini-Henry. Neither of these peculiarities, as far as I know, is particularised in the official reports on the arm. First. The hardened projectile used with the Henry rifling scarcely ever bears the mark of the rifling on the surface of the metal after being fired, certainly never on that portion of the bullet in front of the canelure, and very seldom on the narrow rim below the canelure. The only marks I have been able to trace on the large number of these bullets I have recovered in an almost uninjured state, were those caused by the plaiting on the neck of the case, and which were imprinted on the bullet by the choking. It is clear, therefore, that this projectile gets rotation principally by means of the wrapping or jacket upon it. The wrapping is also the chief means of preventing the gas escaping along the rifling; for in reality the Henry heptagonal rifling is not what may be termed fine,—it is peculiarly defined, and, as may be seen, there is considerable windage when the bullet is inserted naked in the bore. The fact, however, that the Henry projectile has scarcely any mark of rifling on its surface after it leaves the bore, somewhat lessens

resistance to progressive motion, and thereby gives it an advantage in after flight, as well as in penetration. Secondly. The other peculiarity to which I referred, and which I may say is now rather notorious, is the excessive recoil of the arm with which the Henry barrel is officially connected. This recoil cannot be entirely the result of resistance to the initial motion of the projectile, as that touches but lightly on the rifling; nor can it be altogether the result of its weight, one oz. of 480 grains (strange to say, it is weighed as if it were precious metal, by Troy weight); nor can it be ascribed altogether to the 85 grain powder-charge: but these, together with the peculiarly defined pattern of rifling and the sharp pitch (one turn in 18 inches), go far to account for it. This brings me to the subject of pitch. But before leaving the subject of pattern, I would remark that in rifling of every description (and in the polygonal patterns especially) a portion of the surface of the original cylinder—the true bore—is cut away; moreover, this is accomplished by an uncertain method and with a faulty instrument:—the more, therefore, of a true cylinder left uncut or unscraped away the better,—until a more perfect means of rifling is discovered.

Pitch in rifling is resistance to the direct progressive motion of the projectile through the bore. This resistance varies according to the incline as well as the pattern of rifling; for as the more defined the pattern the more the resistance, so the sharper the pitch, the greater the rotation of projectile round the axis of progression, and consequently the more difficult its initial and the slower its direct forward motion. Now, all else, save pitch of rifling, being equal, it is plain that the greater the initial resistance offered to the forward motion of the projectile, the greater the recoil; and I submit that, in after flight, the higher the rotation, the lower the velocity, and consequently the higher the curve of trajectory;—although the ultimate accuracy of direction may be not wholly unsatisfactory. It is not a matter for surprise, therefore, that the pitch of rifling has been the subject of experiments as numerous and curious as has the pattern. In rifled small-arms, we find pitch varying in degree from one turn in 18 inches, and even less, to one turn in 78 or 80 inches—this, with an even pitch throughout. Further, there are small-arms with a reputation, having a pitch increasing from breech to muzzle. I understand large guns are being rifled on this latter principle.

As regards an increasing pitch, when used in small arms with a projectile of yielding material and fine rifling (which, with this description of pitch, is the best), there is, to a certain extent, I believe, a waste of propelling power, not alone from the continued and increasing resistance offered to the passage of the projectile from breech to muzzle, but also from the continued alteration which its surface has to undergo in order to conform to the continually changing incline of pitch. When the projectile is of unyielding material, I confess I find it difficult to understand how, if it be a male screw fitting any one portion of the rifling, it can be driven along a bore having an uneven spiral without injury to one or both. In mechanics, there is no provision, so far as I know, to ensure harmony in such an ill-matched union. Unquestion-

ably, recoil is diminished somewhat by the lessened resistance offered by slow pitch to the initial motion of the projectile in the bore. Increased pitch *at the muzzle* also gives increased rotation, but it is doubtful whether this high rotation is desirable at the expense of flatness of trajectory.

A pitch decreasing from breech to muzzle was proposed, I believe, long since by Mr. Greener, and I myself have had the curiosity to try it. The results are rather the reverse of those obtained by increasing pitch:—very high initial velocity, but uncertain accuracy of direction at the longer ranges.

To the effects which the direction of pitch of rifling has on the flight of projectiles, I shall refer presently.

With reference to the *manufacture* of rifles, I presume it is known that rifling is formed by planing or scratching away portions of the inner surface of the bore. The instrument employed in doing this is known as a cutter: this is fixed in a cutter-box, *i.e.*, in a cylinder fitting the bore as nearly as practicable; in fact, the cutter is nothing more or less than a planing iron, the cylindrical box in which it is fixed answering to the plane or stock. (I have here a cutter and cutter-box for the Henry rifling.)

This cutter-box, with the cutter, is made by means of the rifling machine to revolve at the required angle of pitch when travelling through the bore, and to shift its position at each cut as required by the pattern of rifle. Now it is evident that this is not a perfect instrument, inasmuch as the exact and uniform action of the cutter on the metal of the bore must depend on the evenness of density and texture of the metal composing the barrel; and it is simply impossible to obtain tubes of even density and texture throughout. Further, the action of the cutter will be influenced by the velocity with which it is made to move through the tube, and by the spring of the rod to which it is attached.

The only attempt at improvement on this system of manufacture has been a proposal to punch or draw the rifling, and to the successful accomplishment of this, the length of tube required to be rifled has hitherto been an obstacle.

I shall now explain the system of rifling alluded to as a novelty in the early part of my paper, viz., "part" rifling. Figs. 8—16.

This system, which is the invention of Wm. Murphy, Esq., of Richmond, Cork, is certainly exceptional. It cannot be said to be rifling of a new pattern, since it embraces every known pattern; nor can it be referred to under the head of pitch, as it is applicable to pitch of any and every degree.

The invention consists in rifling, with *inclined* rifling, only a portion of the bore—a comparatively small portion—towards, or at the muzzle, the rifling being dispensed with in a large portion of the bore in front of the seat of shot, where it has hitherto been an impediment to the initial motion of the projectile, and consequently a cause of recoil. The peculiarity and novelty of the system consist in some measure in confining the rifling, not only to that portion of the bore where alone (as I have proved by experiment) rifling can be necessary, but to the

very portion of it which has hitherto been considered the weakest,—where, in fact, any impediment to the free exit of the bullet has been considered to involve the destruction of the arm.

The inventor claims for his system the following advantages:—First, from the position of the rifling, facility for punching, drawing, or cutting, and accurately gauging the same. Secondly, a great reduction of recoil, without any reduction of charge or increase in the weight of the arm. Thirdly, increased velocity of projectile, and consequent flatness of trajectory, without any loss of accuracy of direction. And, though last not least, a very considerable reduction in the cost of manufacture, with more exact evenness of pitch and form of rifling, consequent mainly on the small portion of bore that will be rifled.

Mr. Murphy contends that the fact of the surface of the projectile having to travel along the incline of the rifling towards or near the muzzle, only, retards slightly, without unduly checking, the velocity at that point, and that, in consequence, a larger quantity of the powder charge is consumed, and a somewhat greater power thus finally applied to expel the projectile from the bore than with the ordinary rifle.* In the case of this latter, the increasing velocity of the projectile is unimpeded, save by the column of air in the barrel, until it escapes from the muzzle, except when increasing pitch is used.

In August, 1871, Mr. Murphy placed his invention in my hands, and since that date I have subjected the system to extended trials with many arms having rifling of various patterns and degrees of pitch. My experience with these rifles, which extends to the firing of several thousand rounds of ammunition, enables me to state that the claims of the inventor have been borne out, to an unusual extent as inventions go; and this, too, under the difficulties attending primary hand manufacture, and a supply of ammunition of the most faulty and uncertain description that I have ever used—the only supply open to me.

With a Martini-Henry rifle, bitted out to within four inches of the muzzle, using the regulation cartridge, I have at 400 yards obtained very satisfactory shooting with elevation for 300 yards only. With a barrel rifled on Mr. Murphy's rib system, having the same length of rifling as above, I have, also with the regulation cartridge, at 500 yards got good targets with 400 yards elevation; at 600 yards, with sighting for 450; and at 700 yards with elevation for 550. With a Peabody-Murphy, the trajectory flattens in like ratio as with the last-named arm, as you get further from the target. With a Henry barrel attached to a Westley-Richards breech-action, using the Westley-Richards cartridge (76 grains powder, 480 grains projectile), I have got equally good results as regards trajectory, with extreme accuracy of direction. Lastly, not to weary you with a further account of experiments, I have, with a Navy Enfield, obtained admirable shooting up to 600 yards, but with less gain in flatness of trajectory, owing to the thinness of the metal at the muzzle.

I am happy to see here to-day, some whose opinions on the subject

* I need scarcely remark that in all arms a certain amount of the powder-charge is blown away unconsumed; and this portion of the charge Mr. Murphy claims to utilize.

of fire-arms must be considered of the highest scientific value, who were present on some of these occasions, and to whom I feel I may confidently refer as to the success of the system. An invention which contradicts so much of our teaching and theory of rifling, will, I make no doubt, meet with opposition; but I have every confidence that when the principle is known, and the system fully and fairly tested, this arm will find its place.

I cannot hesitate to express my conviction—a conviction founded not on theory, but, as I have said, upon extended practice—that rifling barrels all through, from the seat of shot to the muzzle, is, for all the advantages that rifling is intended to secure, unnecessary, and simply a waste of time, metal, and labour—which means money.

I have now arrived at the last division of my subject, viz., the effect which each pattern of rifling and degree of pitch has on the velocity of the projectile, and on the arm with regard to recoil, &c., &c.

What I have already said under the head of pattern leaves but little for me to add regarding it. I would, however, make one or two remarks founded on late practical experience.

In the first place, independent altogether of the weight of the projectile and the resistance offered to its initial motion in the bore, the pattern of rifling—when the bore is rifled throughout—has, in itself, some influence on recoil. Coarse rifling, as well as sharp pitch, offers resistance to the rapid expansion of the product of the powder-charge. As in the case of the projectile, so with the powder-charge, the coarser the rifling and sharper the pitch, the more decided the resistance. With barrels rifled with coarse rifling and sharp pitch, I have found perceptible recoil even when using blank ammunition closed only with a wad. This recoil I could not detect so clearly in barrels with finer rifling and slower pitch, fired under precisely the same conditions as regards ammunition and weight of arm.

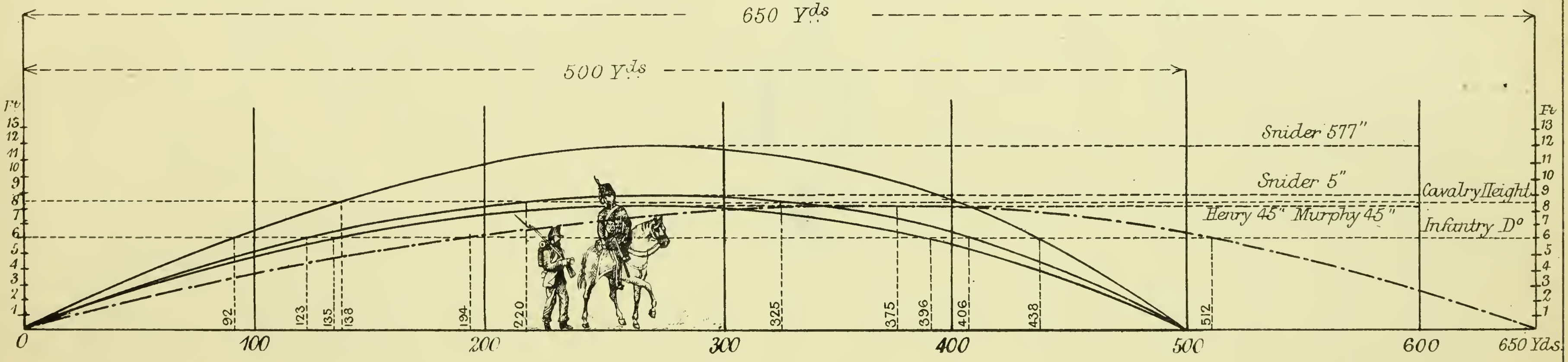
With reference to the pattern of rifling adopted by the Government, I prefer the nine to the seven rifled Henry barrel, not alone because the rifling is of necessity finer, but because I have had somewhat more even practice from it. The pitch, nevertheless—one turn in eighteen inches—is objectionable, as it occasions recoil.

The pitch of screw in rifled barrels is, I contend, about the most important part of the manufacture; for on the incline of rifling depends, in a great measure, the value of the arm as regards velocity and its results, *i.e.*, flatness of trajectory, &c. It is impossible that a bullet can spin with high rapidity, and at the same time travel with high velocity. Rapidity of rotation takes from velocity of progression. Therefore, the slower the pitch, consistent with steady rotation to a *defined* range —all other conditions being equal—the higher can be the velocity; and the higher the velocity, the flatter the trajectory and the shorter the dangerous space (that is, our "catch and graze"). I go further, and submit that comparatively slow rotation, with medium velocity, increases with every increase of the velocity; therefore, in a rifle, accuracy, lateral as well as vertical, can be obtained by velocity.

I need not impress on this professional assembly the advantage of

TRAJECTORIES OF

SNIDER ·577" & ·5" HENRY·45" & MURPHY ·45" BARRELS.



	Snider·577" Bore	Snider·5" Bore	Henry·45" Bore	Murphy
Safe Distance Cavalry	138 to 400 yds.	220 to 325 yds.	nil	650 yds.
D°. D°. Infantry	92 to 438 yds.	123 to 406 yds.	135 to 396 yds	
Highest point of Trajectory	11 ft. 10¾ ins.	8 ft 10¾ ins.	8 ft 1¾ ins.	8 ft. 1¾ ins.

J. Jobbins.

flat trajectory in a military arm. Such a trajectory—say extreme height of curve above the level of the ground six feet in as many hundred yards—facilitates the training of the soldier, as it renders instruction in judging distance an easier task, if not altogether unnecessary. Moreover, it does away with the use of the complicated elevating scale or back-sight; to train the recruit in the use of which, requires time. To adjust this sight for use also takes time—time which, I much doubt, a soldier, no matter how well-trained, would bestow in the hurry and excitement of firing in action, or when an object suddenly offers as a mark. An elevating sight of one *leaf*, or at most two *leaves*, ought, with a trajectory such as I have named above, to be sufficient for accuracy up to 600 yards.

A sportsman, when following large game, would not think of using a complicated elevating sight, for, while adjusting it, his opportunity would be lost. The efforts of every manufacturer of sporting rifles are directed to securing the advantage of a flat trajectory to the longest range. But, strange to say, among the numerous expedients resorted to for attaining the desired end—such as large powder charge and light projectile, &c.—a slower pitch of rifling, with powder charge of suitable combustion, does not appear to have had adequate trial.

I am not aware that the extreme range at which our military rifles are, in the hands of the soldier, expected to be practically effective, has yet been clearly defined. I cannot suppose that the extreme range to which the rifles of the present day are sighted, namely 900 yards for the Snider and 1,300 for the Martini-Henry, can be seriously considered practical for troops. A man at 800 or 900 yards is not so good a mark as a quart bottle would be at 150. And, taking into consideration the time a bullet takes to travel the longer distance, and the obstacles to accuracy it has to encounter in its passage, I think you will agree with me that the chances of striking the bottle would be much greater than of striking the man.

It appears to me, therefore, that the first thing is to determine the really practical range for accuracy required in the military rifle; and the arm giving the flattest trajectory to the specified range must be the best—convenience to the soldier with reference to recoil, weight of arm and ammunition, being duly considered.

The *direction* of pitch is also of much importance in rifling. In our military arms of the present day, the pitch of rifling, the pull of the trigger, and the recoil of the arm, are all to the right, and are consequently incentives to error of shooting to the right. I presume it is known here that our military small arms are accurately sighted, as regards *direction* but for *one* range, viz., for 500 yards. The result is, that the sights, as placed on the barrel, are not vertically true with the axis of the bore; and, as a consequence, the sighting for every range, except 500 yards, is more or less inaccurate. In hand rifles, to use an old term, no allowance is made for the drift due to spin of projectile, or "*dérivation.*" *Drift* there is in small arms as certainly as there is "*dérivation*" in large guns. I would therefore suggest that, so long as the military rifle is fired from the right shoulder, the pitch of rifling should be reversed, that is, should run from right to left; and that the

sights of the arm should be placed vertical with the axis. Thus the "*dérivation*" would be counteracted by the pull of trigger and the recoil, and the sighting—which would be true to the axis of the bore—would be correct for all ranges. I speak from experience, as in many of the arms I have used, and especially with Mr. Murphy's system of rifling, the pitch was a left pitch. In proof of what I state, I found when firing from the shoulder that the pull of trigger had the effect of correcting the *deviation* due to spin to a greater extent than when fired from a rest.

Apart from pattern and pitch, there are several points in the manufacture of the rifled barrel which are much overlooked, and which claim more than a passing remark. In the first place, the thickness and evenness of the metal round the bore at the muzzle have great influence on accuracy generally, but particularly on trajectory. It is the regulated custom to have the metal of the barrel at the muzzle slight, in order, as it is stated, to make the rifle lighter to carry, and easier to take aim with. This is a fallacy, and sacrifices both flatness of trajectory and general accuracy. The rifles of our forefathers were formed on a truer though rougher principle, as the old rifles on the table prove. The more even the thickness of metal from breech to muzzle, the more even its expansion, and the more accurate the shooting of the arm. I have obtained from rifles, particularly those on Mr. Murphy's system of rifling, *different degrees of flatness of trajectory according to the thickness* of metal round the muzzle. The stouter the metal, the less its expansion, and the flatter the trajectory.

The metal at the muzzle should be of even thickness all round, in order to give even pressure and expansion: this is a point of no slight importance in the manufacture of rifle barrels.

Slightly easing the rifling immediately inside the muzzle, is also an aid to accuracy, since it allows the bullet to slip away with ease from the bore at that particular point. Nipping the bullet at the muzzle is certainly a cause of inaccuracy: I have here a barrel which gives proof of this in a remarkable degree.

Again, the fewer and smaller the lumps or blocks of metal fixed to the outer surface of the barrel, the more even will be the expansion throughout. The Chassepôt barrel would be far more accurate but for the block for the sword-catch, which compels a counter-balancing block on the opposite side. Moreover, brazing on blocks of metal for the sword-bayonet, or for the sights, causes injury to the bore, particularly if the barrel is slight. This is a fact well known to barrel manufacturers. In proof of it, I have two barrels here. In one, the interior of the barrel is imperfect under the block for the sword-catch; in the other, it is injured under the foresight. For the above reasons, I would suggest that the block of the foresight should be placed more than the length of the projectile from the muzzle of the arm.

Bands on a barrel are also, if I may venture to say so, detrimental to even expansion, and consequently to accuracy. To all who use a divided stocked arm, this must be evident. The bands, as well as the half-stock, of the Martini-Henry have to be pinned, in order to prevent their being carried away over the muzzle by the wave of metal

consequent on the passage of the bullet up the bore ; and, besides, this fastening on necessitates the fixing of an additional lump of metal on the surface of the barrel.

Lastly, I would say a few words about fouling in rifle barrels. Rifling, as I have already stated, was originally adopted as a receptacle for fouling, and, though in latter days used for the different purpose of rotating the bullet, it must and does continue to harbour fouling. It was to facilitate the clearing out of this refuse, that wads, patches and other expedients were tried, and paper wrappings first proposed, —if I am not mistaken, by General Boileau.

By leaving the greater portion of the barrel smooth, on Mr. Murphy's system, the area of drainage for deposit of fouling is reduced, and the facility for clearing it away largely increased. However, I maintain that on the *cartridge* mainly devolves the duty of removing the fouling; and the smooth bore affords increased facility for this. Unfortunately, the description of cartridge I have been compelled to use, is not the most efficient in this respect. Nevertheless, I have fired more than 100 rounds per barrel at a time, from nearly all the barrels converted on this system, without cleaning, and without having a strip, or failure as regards vertical accuracy. Of course, when I first commenced testing this system, there were failures, and bullets left the bore without taking the rifling.

In concluding my paper, I would state that I shall feel amply rewarded for any trouble I may have taken in putting it together, if it throws a new light of any value on the subject of rifles and rifling.

Commander W. Dawson, R.N. : I would venture to make a few observations on the system of "part" rifling. It was about 18 months' ago, when I began the scientific study of the rifling of great guns, that one of the chief artillerists of the day advised me to make the acquaintance of Captain O'Hea, inasmuch as, he said, Captain O'Hea knew more about the principles of rifling than any man alive. I got an introduction accordingly, and since then I have been in communication with Captain O'Hea from time to time, during the progress of his numerous and varied experiments, and he told me the marvellous progressive results which he successively attained. These experimental results appeared to me so marvellous that they cost me a great deal of study and thought to understand their why and their wherefore. It does appear at first sight very marvellous that taking almost the whole of the rifling out of any rifled small-arm, and leaving only from three to four inches at the muzzle, should produce a very low trajectory without any diminution of accuracy. A week or two ago I went to Wormwood Scrubbs and found a wheelbarrow full of different kinds of hand rifles, including amongst others the Martini-Henry, the Snider, the Westley-Richards, and the Murphy rifles. Every one of them was treated on the same "part" plan, the rifling being taken out of their barrels, except about three inches at the muzzle. A skilful volunteer marksman came on the field who had never seen one of these pieces before, and did not know anything at all about the "part" system. I stood by while he fired at 400, 500, and 600 yards, and I noticed the great diminution in the height of the sights. For instance, at 600 yards, the sight was raised for about 450 yards. And I found that this marksman was particularly struck with the small amount of recoil,—that whereas with an ordinary rifle his shoulder would have felt a very severe recoil, with these "part" rifles the recoil was very small. As to the accuracy of the piece, it was not possible to form a conclusive opinion, as it was a very windy day, but there was nothing to indicate that accuracy had been sacrificed in the slightest degree. What struck me as very marvellous was that in the course of a day's firing, with so many varieties of "part" rifling, there was not a single strip ; I expected to have seen some

strips, for the ammunition was exceedingly bad, independently of the novelty of the "part" system. I have been greatly interested to discover the cause of the success of this "part" rifling. It has always appeared to me that like conditions must produce like results, whether in a small arm barrel, or in a great gun. If the results be different, it is clear the conditions must be different. I was, therefore, very much puzzled to discover wherein the conditions were unlike, which produced such apparently diverse results;—for example, to divine how it was that this part rifling at the muzzle produced a lower trajectory, which means a higher velocity and less recoil, while an increasing spiral in the great gun produces a much lower velocity, and higher pressure than an uniform spiral. The two conditions clearly cannot be the same if the results be so opposite. I investigated the point rather closely, to try and discover wherein the difference lay. Experiments made with great guns shew that nine-tenths of the velocity is obtained in the passage of the shot up the barrel before it has reached half-way out of the bore; and the hand rifle being so much longer in proportion to its calibre, nine-tenths of the bullet's velocity would be obtained long before it has reached half the length of the barrel in small arms. That being the case it is plain that any resistance offered to the shot before it reaches half-way up the barrel, must have a most objectionable effect on the velocity. But in the Murphy system of part rifling, the shot is not checked by friction or resistance, whilst attaining that nine-tenths of its velocity, which would, in consequence be much higher than the maximum velocity in other systems of rifling. The maximum velocity is then very much greater in the "part" rifling at the muzzle than it otherwise would be, and there is very little of the increment of velocity thus gained, subtracted by cutting the grooves in the outer surface of the bullet in passing over the four inches of rifling at the muzzle. In the case of the increasing spiral in heavy ordnance, which gives "decidedly the lowest velocities" the opposite condition obtained. The increasing spiral begins to operate directly after the shot leaves its seat, and it applies an ever-increasing resistance to the shot during its passage along the bore. It is a familiar incident known to all sailors that a ship going at full speed may run on a mud bank, and be brought to a dead standstill by the gradual resistance of the recoil against the ship's bottom, without any one on board knowing of the occurrence. Similarly a ship like the "Devastation," of 9,000 tons, proceeding at full speed, might easily be brought to a standstill, with a rope of three or four inches in diameter, if it were only payed-out gradually, with a steadily increasing strain. It is an ever-increasing range, and an ever-increasing resistance in the form of air which brings the highest velocity shot to a stop at the end of its range, and an ever-increasing force applied to any body in motion will bring it gradually to a stand-still, very much in the same way that the increasing spiral causes the great gun so rifled to have "decidedly the lowest velocities." There was another circumstance in connection with Captain O'Hea's numerous and varied experiments which puzzled me not a little, which was this: Under this system of "part" rifling there is very little recoil. Now it is found in a heavy gun that when an elongated iron shot is fired, the maximum powder-pressure in the chamber (which is represented by the recoil in small arms), is very nearly as great if the cylinder be unrifled as if it is rifled with two studs. The conditions, however, are not alike. When an unrifled iron cylinder is passing out of a heavy gun its body is resting on the bottom of the barrel, and obstructed by the fouling matter in front of its lower side, and there is a great space of windage above it as the shot is not centred. The essential part of all rifling is that the shot should be centred; that is to say that the axis of the shot and of the barrel should correspond. And with reference to a statement made by Captain O'Hea, as to centring, I may say that Captain Scott's is not the only system which centres its shot, although in my judgment he centres it in the best way, that is to say with the least strain upon the gun and projectile, and the greatest windage. Whitworth and Lancaster also centre their shot. All good artillerists aim at centring their projectiles, but they arrive at it by plans of different degrees of excellence. Centring the projectile is considered essential by all practical artillerists. Where there is no rifling at all in the iron cylinder there cannot be any centring, and, therefore, there is an oblique movement in the barrel which offers resistance to the escape of the shot and gives it a wriggling or wobbling motion in

the bore, and then the shot, scraping against the bottom of the barrel, meets a further resistance which tends also to increase the wobbling motion, and the powder-pressure behind the shot accumulates almost as high and as irregular as if the shot was balanced in unstable equilibrum upon two studs nearly under its centre of gravity. But in the case of the small-arm barrel the paper round the bullet keeps the centre of the bullet practically in the centre of the piece and takes away whatever windage would otherwise be above the bullet, so that during its passage along the smooth part of the barrel there really is no "oblique movement of the axis" or wobbling motion. In the ordinary smooth-bore small arm, there are, therefore, different mechanical actions and different conditions from the smooth-bore great gun, both firing elongated bullets. In the smooth-bore small arm with elongated bullet, wrapped in paper, there is very little friction and no oblique movement to diminish the velocity, and by the time the shot has arrived half way up the barrel, nine-tenths of the maximum velocity is attained with the least amount of obstruction, and the increment of stored up force thus gained enables it to overcome the resistance suddenly placed upon it at the end, without an equal decrement of velocity. That appears to me to be the natural explanation of the difference between the high velocities of part rifling and the low velocities of increasing spirals, and between the small recoil or low powder-pressure of part rifling, and the high pressures in Woolwich ordnance. It struck me in thinking over this question of the recoil that there ought to be, if there is not, some way by which the recoil of small arms could be scientifically measured. My own notion is that if there were such an instrument of sufficient delicacy of measurement invented, it would be found that without any bullet at all in the bore, but firing the same sized powder charge, there was a different amount of resistance due to diversities of the pitch and of the coarseness of the rifling, quite independent of the presence of the bullet. If, then, bullets were employed it would probably also be found that different systems of rifling and angles of twist gave different degrees of recoil, and that in proportion to the severity of the recoil would be the height of the trajectory, that is to say, the diminution of the velocity. Strange as it seems at first sight, yet so it is, that whenever the pressure within the powder chamber is highest, there proportionately the velocity is lowest, showing that the high powder pressure arises from the extra resistance offered to the exit of the bullet. The only one of the diagrams before me which I am inclined to cavil at is the iron shot for heavy ordnance represented by diagram, fig. 16. It has not been explained to-day, but I am not sure whether Captain O'Hea told me that he had actually tried experiments with the iron shot shewn in that figure or not. (Captain O'Hea: I have never tried them.) There has been a controversy between Captain O'Hea and myself, as to the application of "part"-rifling to heavy ordnance being possible. That was the only point on which I was prepared to offer anything like an adverse criticism. But the remarkable points that impress themselves on my own mind are these, that the power required to rotate any projectile is exceedingly small, and that it is never that power which injures a gun or destroys it, it is the misapplication of some other power in the unmechanical attempt to rotate it on a wrong principle that does it. It is not the actual power necessary for rotation which injures guns. The smallness of the force required to produce adequate rotation has been repeatedly brought out by mathematicians, and though some of these calculations are based on data with which I do not altogether agree, still the calculations are made by some very learned and clever mathematicians, who prove that the force required to rotate any projectile is a small fraction of the force required to drive it onwards. Another point which also strikes me with reference to Captain O'Hea's numerous and varied experiments is, what great differences in velocity follow from very slight alterations in the mechanical conditions of the rifling, the touch of a file or biting instrument makes 100 yards difference in the range; hence the great importance of studying the mechanical principles of rifling if we would not have "decidedly the lowest velocities" in our great guns. The slightest extra resistance necessarily produces less velocity, even though it brings with it extra recoil or powder pressure within the barrel.

Captain O'Hea: Figure 16 represents a plan for heavy ordnance. The shot is represented as in the bore, in the act of being transferred from the straight, or guiding

rifling on to the inclined, or rotating rifling. It is clear that if the shot were allowed to travel up the bore without a guide, the grooves on it (which are to be filled with lead or other soft metal) may not exactly run, or be truly delivered, on to the inclined rifling at or towards the muzzle; and the consequence might be either tearing of the rifling in the bore or on the shot, or fracture. Mr. Murphy therefore proposes the novel expedient of using straight and inclined rifling, distinct and separate, in one and the same bore, the straight rifles (which may be few) as guides to ensure the hard metal projectile being safely transferred to the inclined rifling, and the shot sent spinning round the longer axis from the muzzle. He also proposes to use a lead-coated shot (fig. 18), or a shot banded on the Vavasour system, to fire from a bore rifled only at or towards the muzzle as shown in the figure 17. This system of rifling heavy ordnance has not been tried. I have not tried it in either case, so cannot speak of it with certainty.

Commander Dawson: I should like to make a further remark, viz., that there is a vast difference between the proposal for heavy ordnance and what Captain O'Hea has actually carried out with small arms. There is this difference, that whilst this proposal is speculative and prospective, the part rifling in small arms is an actual accomplished fact, and it is to actual accomplished facts that I have been referring, not to prospective speculations. I can see myself what I should think are serious objections to the application of part rifling to iron shot in heavy ordnance, but Captain O'Hea has, by his multiplied experiments, discovered so many marvellous things in connection with our small-arm rifling, that I might possibly prove a false prophet. But one of the objections that strikes one is that in the heavy gun there would be no centring of the projectile until it got near the muzzle, and that in that part of the bore in which it acquires nine-tenths of its velocity, it would be subject to all those objectionable oblique movements of the axis of which I have spoken. That appears to me to be a crucial objection to the proposed application of the system of part rifling to heavy projectiles in great guns.

Captain Selwyn, R.N.: I rise to give my testimony, as a witness of these experiments, which have been to my mind most satisfactory, and I attribute a great deal of the success to the fact of the increased velocity doing away with the necessity for the use of a very sharply inclined spiral. The instant we get increased velocity it means precisely the same thing as increasing the spiral, but without the objectionable features, that is to say, that over the given length of rifling, the projectile has travelled in less time, and has therefore set up a more rapid rotation without encountering the resistance which would have been encountered had that object been obtained by increasing the pitch of the rifling. This system is thoroughly deserving of further experiment, and is one to which Government attention should properly be drawn. It is not one which ought to be left at the charges of a private individual, beyond the point at which Captain O'Hea has arrived in proving it. With regard to its development in larger ordnance, I think a simpler, and probably a more satisfactory mode of accomplishing the same object, at least for field purposes,—how much further, yet remains to be seen,—will be the use of the shot the French are now adopting, with inserted material, soft metal surrounding the hard shot. Copper is generally used as most adapted for the purpose, and we may be quite sure it will behave in anything up to 9-pounder or 18-pounder guns very much as lead would do in the smaller arms. The question of fouling, which is a very important one, will never be satisfactorily decided in my mind (though I have seen no fouling whatever during the days that I have been witness of the experiments) till we have extended experiments in all kinds of weather; for those who have used rifles must know that on a day on which you cannot detect the least atmospheric difference, somehow or other the powder behaves differently in your rifling, and you get hard fouling on one day, whereas on another there is not the slightest trace of it. Therefore even if there should be on some occasions fouling, I should like to test other rifles at the same time to see whether they do not foul also, and to a much greater extent; for I think that in the absence of rifling near the seat of the bullet it will be found that that point of fouling has been entirely obviated. I think of the two kinds of fouling, one near the breach and the other near the muzzle, it will be admitted the most difficult to treat or to do anything with, is that near the seat of the bullet. The one at the muzzle can be very easily got rid of with a little oil and a very small instrument for the

purpose. But we could never manage to remove satisfactorily the lead deposit and the hard fouling which generally occurs at the lower point, without much more delay and more elaborate appliances. As regards rifling, I have myself given a good deal of attention to the different forms of rifling, and I must say, as far as I can yet ascertain in small arms, it remains, as Captain O'Hea has described it, a matter of fancy. You may have fine rifling advantageously opposed to coarse rifling, but as to the form of the rifling there are as many opinions as rifles, and, except that I demur altogether to anything like hexagonal rifling, because it involves a peculiarly fitted projectile, which would involve a peculiarly fitting cartridge in small arms, and which again would prevent a man readily placing his cartridge in the bore, to a certain extent. Except that rifling, which I think objectionable, I do not know that any of the others are not subjects of fair trial with this system, and I am of opinion that we shall get results very nearly equal to those which Captain O'Hea has stated, from all.

Captain Scott, R.N.: I think we gather from Captain O'Hea's paper how very important it is at the present time that we should have further experiments, with the view of ascertaining the best system of rifling. At the time of the later experiments, whether we take those with small arms or with great guns—I allude to those which decided the adoption of the national weapons—our knowledge was extremely limited. It has since that time increased very considerably, and we now have not only the actual results of trials to guide us, but in most cases we have also gained the knowledge of the causes of the failures which have occurred. Captain O'Hea has dealt almost entirely with the small arm. To draw any conclusions from the result of the small arm as to probable results with great guns, would, I think, lead into great error. In the small arm we have a leaden bullet which expands, closes the windage, and goes evenly along the bore ; but in the great gun we have an iron shot, which, if it be not centred, rubs along the bottom of the bore, and hence, the pressure of the gas upon its top being very considerable and bearing it downwards, greatly increases the friction. The fouling which lies in the bore adds further to the friction, and thus, in the case of the shot and rifling shown in the diagram, there would be an enormous amount of rubbing before the shot could catch the rib, which, in Fig. No. 16, Captain O'Hea has brought to our notice. But I think, if he will allow me, I can show him that a heavy gun, if rifled as that shown, would not succeed. With one guiding-rib the shot's irregular motion throughout the bore of the gun would tend very much to reduce its velocity. With two ribs, the result would be better, but if the gun had three ribs the shot would be centred at first starting. I think also that the great change from a straight line to taking up a sharp incline near the muzzle would, with heavy shot, cause a very serious strain, and that even altering its movement in the slightest degree would tend to injure the gun. I believe it would be found that if the rifled shot with hard wings were used instead, it would leave the gun with quite as high a velocity as a smooth cylindrical shot, and would probably not put more pressure upon the gun. In the case of the smooth cylinder, the shot being nearly of the size of the bore of the gun, the cylinder would rub along the bottom, and would necessarily, from the friction on its heavy surface, have an irregular motion throughout, combined with an enormous amount of friction from clearing away before it the fouling which lies at the bottom of the bore. But in the case of the rifled shot it would be resting, as it were, upon three edges or rails only, with the whole of its cylindrical portion, clear of this fouling, and, being balanced upon its three long bearings it would run along steadily, and would slip out more easily, and certainly with less damage to the gun than in the case of the cylinder shown in the diagram. The experiments which have heretofore taken place with great guns are misleading, because they have been made with studded shot, for with a studded shot you have this condition, that directly the powder gases impinge on the shot, the rear stud squeezes up, and the heel of the shot strikes against the bottom of the bore of the gun, and consequently the front of the shot is raised; but directly the powder gases are more fully ignited and rush over the shot, down goes the front, and then the shot rubs along the base the whole way. The studded shot is, in fact, scarcely better than a cylinder in respect of this irregular movement, which Captain Dawson showed us the other day very clearly. An article has appeared in the "Philosophical Magazine" as to the pressure upon the studs of the Woolwich shot, showing that the gaining twist commencing with one turn in a hundred (as in our 18-ton gun), and ending, I think,

with one in forty-five, or one in fifty calibres, gives the same equality of pressure throughout the bore of the gun. If this be so, our heavy guns are wrongly constructed, for they ought not to be thicker at the breech than at the muzzle, and every artillerist knows that the more even the external shape of the barrel is, the more accurate will be the shooting, especially after the gun warms. But as our 35-ton guns, instead of commencing at one turn in one hundred and ending at one in forty-five calibres, commence at 0°, it is clear, if the article referred to be (practically) correct, that the guns are made the wrong way, and that we ought to have turned the muzzle round, so that the muzzle should be the breech and the breech the muzzle of these guns. I hope you will pardon me for taking up your time, but as this is a question that I have specially studied, and not altogether unsuccessfully as to results, for the Committee allowed in the 7-inch gun competition that although the Woolwich system, or those representing it, obtained the first seat in the coach, they were ready to give me the second. Here is the Woolwich shot, resting as it always does on being loaded in the gun, upon its studs. On the gun being fired the powder gases strike the shot, the studs crush up, and the shot goes down and strikes (with its cylinder upon) the bottom of the bore. The action, therefore, cannot be what the article in the "Philosophical Magazine" appears to indicate, for the shot does not go steadily ahead, but on the contrary its first movement is downward and not forward; so that that pressure, instead of being represented by 18 tons on the square inch may actually be 40 or 50 tons on the square inch, which is very much nearer the truth. But what is the condition of the shot when pressed down? If it were possible that I could cut off a barrel and spread before you the mass of fouling which lies at the bottom, you would see that when the shot is forced down on this mass of fouling it must have a tendency to stick to it, for the diameter of the shot being nearly equal to that of the bore of the gun (the windage being only 0·8 inches over its cylindrical portion, it is ·05 only over its studs) the fouling must come nearly half way up its cylinder, and hence when the shot commences to move forward there must be a very great drag along this fouling. Also, when these studs are pressed down a further action takes place, which to many men may be puzzling, especially as the force required to rotate the shot is an exceedingly small one. What is the reason, then, that these studded shots when fired have their studs cut into in such a way? It is not due to the power actually required to turn the shot, but is simply due to this, that the shot being pressed down in the fouling, and kept down by the gas pressing upon it, has to be dragged through this dirt the whole way, and it is the great force required to drag the cylindrical portion of the shot round through the fouling, so as to give it rotation, that actually cuts into the studs, and very often causes them (as we know has happened on several occasions) to slip over the rifling. I point this out to show how very wrong theoretical deductions often are, and how very far they are from the actual results, which, if closely studied, would show us that we have at the present time a very unsatisfactory system of artillery which ought to be at once investigated, so that we may obtain a system in this country which would be at all events up to our present requirements, and on a level with our great mechanical skill. For the same reason we want further experiments on the system Captain O'Hea has so ably shown to have given such extraordinary results with small arms.

Sir William Codrington: There are two points to which I wish to refer. I understood a gentleman near me to mention that in that part of the bore which is smooth, before it comes to the few inches of rifling, there was a rotatory motion given to the bullet. (Captain Selwyn: No.) That is not then the case. There is another point with regard to the bullet used in the Whitworth rifle. I understood it to be asserted that it was necessary to have a hexagonal form, for the purpose of fitting the hexagonal rifling, whereas my impression is, having seen experiments with it, that a cylindrical lead ball was put into the barrel and took the Whitworth rifling.

The Earl of Lauderdale: With regard to Whitworth's rifle, I have always been under the impression, that both his shot for great guns and for small arms were cast in the same mould as the form of the rifle.

Sir William Codrington: I saw a number of experiments with the Whitworth. A cylindrical bullet was tried against the Enfield in those days. That

certainly was a cylindrical bullet put into the hexagonal barrel with which we had many experiments at Woolwich, and with it I remember the Whitworth made a target at 1,400 yards, when the Enfield could not make one at 1,000.

Captain O'Hea: With regard to the part of my paper having reference to the centring of the shot in large guns, I admit that my not mentioning that there were other systems besides Captain Scott's which accomplished the centring of shot, was an oversight consequent on the haste with which my paper was written; but I scarcely think other systems centre as perfectly. As regards the Whitworth, Sir William Codrington is quite correct; there has been remarkably good shooting made with the Whitworth barrel using the cylindro-conoidal projectile; but to use this form of bullet with anything like efficiency in the small arm, a wad—a specially composed wad—either attached to the projectile, or intervening between it and the powder charge, has to be used. (Sir W. Codrington: This is waxed?) A wax or composite wad. My object in speaking of it was simply to point out that to expand the cylindrical bullet into the polygonal rifling you have to expend more powder power on it than would be the case if the form of the rifling were nearer the cylindrical form of the projectile. The distance between the angle of the polygon and the cylinder is considerable, and the powder-charge is compelled to expend, or waste greater power in expanding the cylindrical projectile into the polygonal rifling than if the pattern were finer.

Sir W. Codrington: I only wanted the fact to be made known. I am not competent to discuss the other question in the least; not that I object to Captain O'Hea's explanation.

The Chairman: Before closing the discussion I would wish to make a few observations—first, as regards myself, and secondly, as regards the gallant Officer who has given us this very interesting lecture. I should not have made any reference to my own connection with rifling, if Captain O'Hea had not introduced my name into his paper. We all know that great minds jump together, and it happened at the very time Captain Scott was engaged in designing his form of grooving for heavy guns, I was occupied on the very same subject, in the year 1860, in designing a groove for small arms, and we both arrived at almost identical results! Since 1860 I have made twenty-five to thirty rifles for my own satisfaction and the use of my friends, but I never came forward publicly, further than having presented to this Institution, in 1861 or 1862, three rifles with my pattern of grooving. I have brought here specimens of several of my rifles, and this one (selecting the Spencer) represents most perfectly the principle on which my grooving is formed. It is simply a groove, every portion of which tends to turn the bullet, and therefore it is to some extent the same as Captain Scott's. Two of these pieces of barrels, which I hope gentlemen present will inspect, are what I call perfect specimens of rifling. You cannot see the difference between the cylindrical portion of the barrel and the portion of the grooving. The other one I have brought purposely, because it shows in tint the difference; the boring of the barrel is somewhat coarse, and the rifling is beautifully fine, and you can trace the line of separation between the two by the difference of colour.

I wish also to explain the fact which Captain O'Hea has referred to—viz., that the papering of bullets in breech-loading cartridges is the result of observations of my own. I certainly did make those observations in this Institution, in a discussion which was taking place on rifle cartridges, and also at the Society of Arts; and the occasion which gave rise to the remarks was the practice of some amateurs at Kilburn, who brought cartridges of which the bullets were simply coated with black lead. In the course of six or eight rounds the fouling was so great that we were obliged to leave off shooting, and a gentleman asked me for some of my bullets. I made him 300; he went over to Belgium, and he would have had as many more as I chose to give him. The difference between my bullets and those he was using was simply that mine were papered and greased, while the others were coated with black lead.

I went with Captain O'Hea on Tuesday last to Wormwood Scrubbs, where I found, as has been said, a barrow full of rifles. I tried a Martini-Henry of the Government pattern, a Westley Richards of the same construction, one of Murphy's, and one of Peabody's; the rifling in all having been bored out from the breech to within

3 or 4 inches of the muzzle. We commenced practice—(I say we, because I took turn shots with Captain O'Hea)—at 400 yards, and ended at 700 yards, and the results were precisely as he has stated in his paper. At 400 yards we had an advantage of nearly 100 yards in the sighting; at 700 yards an advantage of 150 yards; and the close of our experiments was, that firing at 700 yards, my three last shots were two centres and a bull's-eye; and I did not feel that it was necessary to go beyond that. There was no strip; we fired 75 rounds, and I am as satisfied as it is possible to be from experiment, that this is a very great invention; that it is one eminently worthy of the countenance of Government, and that it should be continued beyond the range to which Captain O'Hea has been able to go, because we have a progressive improvement from 400 to 700 yards, and I have no doubt whatever as the range increases, the advantage will increase. I certainly agree with the two last speakers (Captains Selwyn and Scott) that this is a subject eminently worthy of the attention of Government, and I hope in any experiments that the authorities may sanction, they will not omit to associate Captain O'Hea with their Committee.

In conclusion, I think I may offer to our gallant and talented friend your best thanks for his lecture, expressing the hope that the subject which he has brought before us may be as successful as others of a kindred character on which lectures have been given in this Institution at times when it has been my good fortune to preside. I allude to Sir Wm. Palliser's shot and guns, to Moncrieff's gun-carriage, and to the muzzle-pivoting carriage.

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LECTURE.

Friday, March 14th, 1873.

General Sir JAMES HOPE GRANT, G.C.B., &c., in the Chair.

ORGANIZATION AND EMPLOYMENT OF CAVALRY.

By Colonel Valentine Baker, h.-p., late 10th Royal Hussars.

The subject which I have the honour to introduce to this meeting to-day, is one which has, during the last few years, attracted the earnest attention of all the military authorities of Europe. Since the introduction of railways and telegraphs, together with improvements in small arms and cannon, great changes have taken place in the tactics of both artillery and infantry, but in neither of these branches has such a complete revolution been effected as has been found imperative in the action of cavalry in the field.

Some may be loth to acknowledge that in actual battle, cavalry do not hold the same position as of old, and may look back with regret to those glorious charges, which in the days of Marlborough, of Frederick the Great, and even in the time of the First Napoleon, so frequently decided the fate of the day. But experience has spoken too strongly and convincingly to leave a shadow of doubt that those splendid opportunities have passed away, and that it is before and after an action, that the main *rôle* of cavalry must lie in the future.

For years past, the real truth was forcing itself forward. In the days of the great wars of Napoleon's era, it was becoming gradually apparent that cavalry could rarely, if ever, act effectively against steady and well-trained infantry.

The introduction first of the percussion-lock and next of arms of precision, made this truth more and more evident, and when breech-loading added rapidity to the accuracy of infantry fire, Officers of experience and weight in all armies were found, who urged that the days of cavalry had passed away, and that this arm in future would only become an encumbrance to an army; and the singularly unimportant part, which the cavalry on both sides had played in the Franco-Austrian War in Italy, seemed almost to justify this conclusion. But far-seeing men of real military genius had already discerned that the action of cavalry in war had changed but not departed. Rising above

petty prejudices and confined views, it had struck them that in the increased rapidity of modern war, early intelligence and information was becoming all important, and that a great and glorious future was already dawning for this arm. Both Austria and Prussia were already acting upon these ideas when the war of 1866 broke out, and although the rapid successes of the Prussian Army rather threw the action of the Austrian Cavalry into the shade, the name of Edelsheim should not be forgotten as a leading and early guide to the new and true action of this arm in coming campaigns.

At the conclusion of that war, so convinced were the Prussians that cavalry used mainly for purposes of intelligence were becoming more and more important, that they made a most considerable increase to this branch of their service.

The war with France gave an insight into what well-instructed cavalry could do when scientifically used. The French had not realised those changes that others had accepted as imperative.

They endeavoured, by devoted gallantry, to maintain the old action and old traditions of their arm, and their cavalry consequently failed on almost every occasion to aid their armies by proper intelligence in the early operations of the war, or to save them from the coming storms when disaster was breaking upon them.

Let us now consider how these lessons of the past may be made useful to us in the future. It becomes the duty of those who have had personal opportunities of watching these great and recent campaigns to ponder seriously over those lessons and to endeavour to apply them for the advantage of their country.

It is this feeling which has induced me to accept the invitation of the Committee, to give a Lecture here to-day, but I trust that in any views I may propound, this meeting will believe that they are advanced with no idea of dogmatizing, but merely as the expression of my own opinions, put forward for the purpose of eliciting that argument and dispassionate consideration, which is ever so useful in the study of military questions.

In considering this subject, I shall mainly refer to possible improvements both in the organization and action of the cavalry of the British Army; and we must never forget that organization ever precedes action, and that theories are useless in war, unless the power exists to give these theories practical application. Here, at the outset, a feeling of discouragement falls upon the British Officer who studies his profession. For however much we may be convinced of the spirit of the British Cavalry Officer, and of the magnificent material that is at our command, we are bound to acknowledge that our regiments are not at present organised for war, and that it would be impossible for them to sustain the stress which war would inevitably throw upon them. A moment's consideration and comparison,—and in war everything is comparative,—will show this to be the case. In all the great continental armies it has been accepted as a military axiom, that cavalry and artillery cannot be improvised, but that a sufficiency of well-trained men for both these arms must be maintained either in the ranks or in reserve, in time of peace; that trained horses are necessary as well as

trained men, and that a sufficiency should always be in the ranks or in immediate reserve, to complete regiments to a war strength and to maintain them effective under the exhausting influences of war.

Thus if we examine the constitution of any foreign cavalry regiment, we shall find that this has not been lost sight of; nearly all have five or six squadrons. They only place four in the field, and the others remain as a reserve to supply their losses, and let us compare the strength at which they would go into the field with that of our own regiments. A North German regiment of cavalry in the field, numbers 691 riding and 16 draught-horses. It has reserves of both horses and men to maintain this strength. But what is the constitution of the British cavalry? We have nine regiments of 384 horses, and ten regiments of 320 horses. They have no reserves of any kind, either in horses or men, and you know that a cavalry soldier takes at least from a year to eighteen months to render him effective in the field.

Thus regiments of this strength would have to go into the field, and maintain themselves in an effective state without any possible means of supply in men, under the exigencies of war and sickness, for a period of a year or eighteen months. But let us only look at the Autumn Manœuvres, and we find that in that short imitation campaign, unaffected by wounds and deaths, and with marvellously few casualties from sickness, the weak regiments were so drained by supplying orderlies and necessary detached parties, that they often only turned out twenty-six files per squadron, and both strong and weak regiments could only put three squadrons into the field.

Imagine what these regiments would have been after a year's hard campaigning, perhaps under unhealthy influences. But we have not even to draw upon our imagination for this picture. I well remember —and I have no doubt there are some in this room who were present— a review of the British cavalry on the Queen's Birthday on the Monastery Heights, in 1855, when the Army was in front of Sebastopol.

The regiments when the war commenced were at a weak strength, and, as at present, they had no reserve of men or horses. The Light Cavalry Brigade then comprised five regiments. Those regiments, if maintained at the strength of North German regiments, would have given a force of 3,455 horses with proper reserves of both men and horses.

These gallant corps had gone through the ordeal of Balaclava, and suffered terrible losses in proportion to their numbers, but so small were those numbers, that this loss, heavy as it was proportionably, only amounted to 387 killed, wounded, and missing. Yet at the review in question, these five regiments could only turn out one squadron—not one squadron each—but actually one squadron, made of Hussars, Light Dragoons, and Lancers amalgamated from the five regiments. This was only ten months after the commencement of the war, and I would ask any Commanding Officer of a weak regiment whether he could hope for a much better result at the end of a year or eighteen months of hard work and sickness unsupported by any reserves.

But the question has not been omitted entirely in the recent reorganization of the Army, and it is, I believe, intended that men should

serve for eight years in the ranks and four in the reserve. But this does not deal with the existing difficulty. It is evident that it will be eight years before this reserve commences, and twelve years before it is fully formed. Even then no reserve of horses will exist, and I will ask any one who has ever commanded a regiment of cavalry, even assuming him to have a sufficiency of reserve men, whether it would be possible, after probably receiving a sudden order for embarcation, to complete his regiment from 320 horses to the war strength of a continental regiment, and to train these horses and render them effective prior to embarcation.

I think that to all cavalry Officers who love their profession, this is a very depressing state of things, for they cannot but feel that their exertions, however energetic or steadfast, would have nothing adequate to work upon in case of war.

But let us trust that this very apparent weakness in our organization will tend to its correction, and let us endeavour to find by every means in our power the most simple method of correcting the evil.

With regard to a proper supply of trained men, this can at present only be accomplished in one way—viz., by maintaining the regiments at a war strength in men until their reserves are created; and as the cavalry soldier without his horse costs but little more than the infantry soldier, it would not require a large augmentation either of numbers or expenditure, to place our cavalry upon an effective footing. I think that the minimum number which should be maintained per regiment should be 750 men, and this amongst our few cavalry regiments would only render a small augmentation of the Army requisite.

It has been urged that the country can never be expected to maintain a war strength of horses in time of peace, and if we had a reserve of horses this argument would be perfectly reasonable. But where is this reserve to come from?

This is a question which is at present occupying much of public attention. In the plan which I am about to propose, I endeavour to deal with the wants of the whole Army, and not only of the cavalry.

This plan is, I have no doubt, open to criticism; but I would ask my critics to remember, that a reserve is absolutely and imperatively necessary.

No one can doubt that the question of a supply of horses for military purposes is becoming daily more important. Modern war, from its rapidity, assumes that an adequate reserve shall be immediately forthcoming, and practical experience tells us that, whatever may be the merits of the present controversy relative to the quantity and quality of horses in this country, they are not to be obtained for the Army with the same facility as of old.

In calculating the reserve which would be sufficient for our probable requirements, two questions arise. Firstly, the supply of horses for defensive, and secondly, the supply of horses for offensive, purposes. It has been assumed, and probably with truth, that, in case of an invasion, a system of requisition would be put in force, and that then both the quantity and quality of the horses in the United Kingdom would prove sufficient for our wants.

But admitting this assumption, it becomes a further question, whether this power, which evidently would not be enforced until a moment of extreme emergency, would leave time for proper selection, distribution, and training.

It must be allowed that, assuming this power to be put in action, a previously known organization would be of advantage both as regards public convenience and private rights.

But if we turn to the offensive action of this country—and it must be admitted that offensive action might become imperative under certain, though perhaps not immediately probable, contingencies—the question of a supply of horses assumes a most serious aspect.

It is scarcely to be supposed that the Government of the country would proceed to enforced requisition for offensive purposes without some previously known and acknowledged liability on the part of horse owners. It is equally certain that an immediate or even rapid supply of the requisite number of horses to place our armies in the field, could not be obtained by any reasonable expenditure of money.

And it must be remembered that, under the conditions of modern war, an Army that cannot be placed in the field, ceases for all practical purposes, to be an Army; and the maintenance of such a force becomes a useless and unnecessary national expenditure.

The recent organization of the regular Army, with its present reserves, would admit of a force of about 100,000 men being placed in the field. It therefore remains to be considered what reserve of horses would be sufficient to complete this force to a war footing, and then to determine how this reserve may be most certainly and conveniently forthcoming.

If this force could not be placed on a war footing, the whole Army of the country would be paralysed either for offence or defence, for it embraces the efficiency of the artillery and cavalry.

These reserves resolve themselves under two heads:—Firstly, horses that must be trained for military purposes. Secondly, ordinary draught-horses.

Under the first head, come the horses to complete the cavalry and the artillery.

Under the second head, engineer train, divisional and corps ammunition columns, and the regimental and ordinary transport.

Let us now first consider the question of a defensive reserve of horses. It is evident that the invasion of this country would never be attempted except with a very large force, and that we should be compelled to meet it with the combined action of regular troops, the militia, and the volunteers. The forces thus employed would probably be most considerable.

It has been assumed that, in war, the direct and indirect supply of horses should be nearly equal to the number of men. But this, under ordinary conditions, where railways are available, becomes an extreme theory.

For this supply in war may be divided under two general heads, viz:—First, the regular horses of the Army, including its organized transport; and secondly, the requisitioned or hired transport, which is

merely used for maintaining the supply of stores and provisions in central or necessary depôts.

As the Prussian regular transport was put to an extreme test during the late war, and as the distinction between the two classes of transport just named was most jealously maintained in that Army under all ordinary circumstances, the number of horses in proportion to the men in a North German Army Corps will give a fair rule for guidance; but it must be remembered that neither tents nor horse-blankets were carried in the waggons, and the carriage of tents and horse-blankets throws the greatest stress upon the transport of an army in first line.

Thus we find that, to a force of 37,507 combatants, 13,802 horses are required, or about 7 to 20.

It is evident that no force, whatever might be its constitution, could be placed in the field, fed, and supplied in face of an enemy, unless at least this number of horses were forthcoming.

Taking for granted that this could only be effected by enforced requisitions, let us now consider whether this extreme measure might not be modified by previous organization, and whether the distribution of the supply thus acquired might not also be much facilitated. To effect this, it is suggested that, in place of the present tax upon horses, an *ad valorem* duty should be imposed; that all horses classed by their owners at a certain value, which would be within the limits of reasonable expenditure for military purposes should be inspected, and that such as were eligible, should be registered. That horses so registered should, by Act of Parliament, be liable to be purchased by the Government at their classed value in case of probable war or invasion. That in consideration for such liability, these horses should be exempted from taxation whilst remaining so registered.

It is evident that this system would provide a sufficient supply of horses for any possible military purposes. It implies no new liability, for it is acknowledged that an enforced requisition would have to be resorted to under such contingencies. It would give the horse owner a previous knowledge of whether his horse was or was not liable to requisition, and in the former case would give him a *quid pro quo* in the shape of exemption from taxation. It would probably rather increase than diminish the amount of revenue derived from this source. If so registered and inspected, these horses might evidently be classed, divided into districts corresponding to the organization of the troops, and arrangements might be made for their immediate purchase and regular distribution in case of necessity.

Let us now consider the question of offensive war, demanding an immediate supply of trained horses, and a more modified supply of ordinary draught-horses.

Into this question another and important consideration also enters.

Autumn Manœuvres have been recognized as a necessary and important part of military training. They demand an annual, but temporary, supply of horses. This supply is at present a source of very heavy expenditure.

It is suggested that both this difficulty and that arising from war might be met through the existing force of Yeomanry.

The Yeomanry force consists of 13,000 horses. The constitution of that force is not at present all that could be desired, and it is most irregularly mounted, comprising many horses of great value, and many that are utterly unfitted for the duties of either cavalry or mounted rifles.

They may be divided into three classes:—Firstly, horses belonging to the better class of farmers, or sporting tradesmen. These are usually excellent. Secondly, horses belonging to small farmers, or the less wealthy farmers' sons. These are often of very indifferent quality, their owners are obliged to maintain horses for purposes of cultivation or for light draught, and they ride them during their military duties. This is the largest class in the Yeomanry. Thirdly, horses hired by men who do not at other times keep them, but join the Yeomanry from ideas of parade and show. This useless class should be got rid of. Its loss would be a gain to the Yeomanry force, and a saving of expenditure to the public service.

It is suggested that the numerous second class might be made available for maintaining a reserve of horses; that, at the same time, the quality of the horses of the Yeomanry would be improved, and that a stimulus might also be given to breeding, through the number of good mares thus thrown into the hands of farmers, for three-fourths of the horses bought for cavalry purposes are mares.

This proposal would be carried out in the following manner:—

Officers commanding cavalry regiments and the Officers buying for the Royal Artillery would be allowed each year to purchase an additional percentage of horses.

These horses would be trained with their respective corps for one year, and the additional percentage so purchased would then be handed over to the Yeomanry, upon the following conditions:—They would keep these horses at their own cost; would ride them when under arms with their regiment; would maintain them in good condition as certified by periodical and reported inspections by the Yeomanry Adjutants.

They would give them up, if required, for five weeks after harvest, for the purposes of Autumn Manœuvres. They would give them up in case of war for regular military purposes, and would, in this case, have them replaced by horses purchased by the Government under the conditions already explained. Farmers belonging to the Yeomanry might be allowed to have an additional reserve artillery draught-horse on the same conditions. On these horses becoming sixteen years old, they would become the property of any man who had kept the same horse for the five previous years. Under other circumstances they would be sold by auction for the Government.

Let us now consider the cost of the proposed plan. In case of war, a reserve of 4,500 horses for the artillery and 2,500 horses for the cavalry would be required = 7,000.

Including probable casualties, this would require an additional annual purchase of 1,000 horses at four years old, say 400 at 40*l.* = 16,000*l.*, and 600 at 45*l.* = 27,000*l.* To this must be added the cost of keeping 1,000 horses for one year at 28*l.* per horse = 28,000*l.*, or a total cost

of 71,000*l*. But the loss on the 2,000 horses for the Autumn Manœuvres of 1872 was about 40,000*l*., and as this loss would be avoided by the system proposed, the actual cost would be about 31,000*l*. The increase from the system of taxation advocated, would probably far exceed this sum.

These horses would be thoroughly trained, used yearly, and would be ready at a moment's notice in case of war.

There is a minor point which is yet worthy of consideration. These horses would have to be trained by the cavalry and artillery. This would throw a greater stress in the way of breaking, upon these services, and it would be only fair that they should reap some reward. It is suggested that, of the whole number of horses required for those two services, they should be allowed to select 50 per cent. The remainder would be awarded by lot to the regulars and Yeomanry. This would give a reward for training, and would, at the same time, guard against careless purchases.

I may state that, from careful inquiries which I have made, there would be very little doubt that the number of horses proposed would be applied for on the terms specified, and if made voluntary, the system would be most popular with the Yeomanry.

Thus, probably at a reduction of actual cost, an efficient reserve of horses might be immediately forthcoming.

It is evidently impossible that the Yeomanry, as at present constituted, can act as a reserve in men for the regular cavalry in time of war; but, it appears to me, that they might thus act as a reserve for horses, and that, if two Yeomanry regiments were linked to every regiment of the regular cavalry, as has been arranged in the connection between the militia and the infantry, I have no doubt that the system I have proposed could be carried out, to the satisfaction of both Yeomanry and regular cavalry.

Before leaving this subject I will touch upon a point which, although thoroughly understood by cavalry officers, is not, I think, generally appreciated by the Army at large; I allude to the proportion of dismounted men considered requisite to keep a cavalry regiment effective in the field. I have often been asked by Officers of great intelligence why this should be the case, and it has been pointed out that in continental regiments it is not the case to the same extent as with ours. But that, I think, is a mistake. English regiments in time of war have to furnish duties which are provided for in time of peace by continental armies. Thus, if we take the staff of a cavalry brigade at the outbreak of a war, we shall find that this staff is furnished by the men of the cavalry regiments composing it. That is not the case with continental armies. A regular staff is maintained, and therefore in time of war, regiments, are not drawn upon to the extent that ours are, and therefore the same proportion of dismounted men is not required.

A little illustration will prove the absolute and imperative necessity, and also the economy of maintaining a certain proportion of dismounted men in time of war. I will take the case of a cavalry regiment on service having no dismounted men. Let us assume that a man and his horse both go sick upon the same day. Trace the result. The man goes into

hospital, but the horse is sick and must be left behind. Another man must be left to take charge of it, and that man remains behind. But that man leaves his horse again, and another man must be detailed to lead this horse. Therefore because one man and one horse go sick, three men and three horses are rendered non-effective. Let us assume the existence of one dismounted man. The one dismounted man would take charge of the sick horse, and the loss to the ranks would be one man and one horse. There would be no further loss ; whereas in the other case there would be a loss of three men and three horses. I think this illustration, although a small one, and one which may be considered rather exaggerated, gives a fair idea of the absolute necessity for having dismounted men in the field.

I have now noticed our system of organization, with regard to the supply of men and horses ; but, whilst dealing with organization, there is another point, of so much importance, that I must not pass it by.

Assuming that our supply of men and horses will some day be made effective, how are we to clothe, arm, and equip them ?

I think it will not be difficult to prove, as I shall attempt hereafter, that the work demanded of modern cavalry will be greatly in excess of that of past days. We all know, from practical experience, the fatal influence of excessive weight upon horses, and it evidently behoves us, in time of peace, to endeavour to diminish that weight as much as is possible, without interfering with the efficiency of the soldier.

My time is too limited to go much into detail upon these points ; I shall, therefore, touch them briefly. Firstly, with regard to clothing, I think I shall express the opinion of the great majority of cavalry Officers when I say that, what we want is a handsome attractive uniform for purposes of parade, and another useful serviceable uniform for purposes of real hard work.

This has recently been recognized in the infantry, let us hope that it will be extended to the cavalry.

There is another point that I must here notice, as affecting heavy cavalry, viz., the use, or disuse, of the cuirass. Now, the evidence afforded by the late war, upon this point, is too strong to be ignored. It was remarked, by everyone who was present on those battle-fields, that cuirasses were rarely, if ever, found pierced with bullets ; but the continental cuirass is different from ours. Years ago, our cuirasses also would turn bullets, but we have now so lightened them, that they are practically useless for this object. I should recommend that a really useful cuirass should be introduced, and that its use should be extended to all of our four heavy cavalry regiments.

Now, with regard to arms, I think that the independent action likely to be accorded to cavalry, certainly demands that both a sword and a carbine should be carried. The first weapon is capable of much improvement and should, I think, be issued in sizes. In the Henry-Martini carbine we shall have a beautiful arm, having the advantage of easy loading and long range. The latter, I consider a most important point for cavalry, as the instances must be very few where they could, or should, use their carbines at short ranges. But it appears to me that the Lancer—and I am an old Lancer myself—is thoroughly

over-armed. Notwithstanding assertions made by American Officers, I believe that a pistol is a demoralizing and dangerous weapon for a cavalry soldier. Moreover, as at present armed, a Lancer is not well qualified for outpost or scouting duties. I would suggest that he should be armed with only a lance and a carbine. The lance is a splendid weapon, if well used. Teach him to rely upon it utterly and implicitly. Moreover, if armed with a carbine, the Lancer would be exceedingly serviceable for any temporary dismounted duties, as he could leave his lance slung upon his horse.

We will now turn to the more important point of the horse equipments, and, although I am warned that I have much important ground to traverse in a limited time, I cannot refrain from making a few remarks upon this subject, for it is one upon which I believe many popular fallacies exist. Certainly, nothing can be more important to cavalry than the well fitting and practical efficiency of their saddlery.

But for some years past it has been the fashion to depreciate our own knowledge with regard to saddlery, and to imagine that on this point they were far ahead of us on the Continent. Common sense will tell us that this ought not to be the case, and experience of continental armies confirms common sense.

Some twenty years ago, it was the fashion to copy everything relative to our cavalry from the Continent. We—a nation with the greatest experience in everything relating to the horse—had no confidence in our own judgment when it had to be applied to cavalry.

But a step was at last made in advance; our cavalry seat was made more English, and an immense improvement in the riding of the men was the consequence, whilst at the same time sore backs—that curse of cavalry—became more rare.

Rely upon it, with all its defects—for it is defective,—the British cavalry saddle is one of the best in Europe, and when you hear of continental cavalry making unprecedented marches without sore backs, do not believe it. Those who make those reports, sincerely believe what they say, but they do not see the rear of the army they are working with. During the late war, I had heard these astounding reports of Prussian marches and the perfection of Prussian saddles.

The year before, I had ridden for many days in a Prussian troop-saddle, and had failed to detect its advantages.

But sleeping one evening during the war in a town about 20 miles in rear of the army, I came upon upwards of 30 horses with some of the worst sore backs I ever saw, belonging to a regiment which is notoriously one of the most effective in the Prussian army.

There are three ways of diminishing sore backs on active service:—

Firstly—by having a good saddle;

Secondly—by diminishing the weight in the saddle; and

Thirdly—by constant and careful attention to details of fitting; and the latter is the most important of all.

I am glad to say that the Saddlers' Company have offered no less than ten prizes, the highest prize being 50*l*. for the best military saddle. Before doing so, they placed themselves in communication with the military authorities, and the latter, fully appreciating the absolute

necessity of lightening the kit, have laid down conditions which should be of great practical use in providing us with a model saddle in the future. I believe that any one may compete for these prizes, and cavalry Officers could not do greater service than by thus bringing their experience to bear.

Let us now consider how the kit can be lightened, and I will ask if anything can look more unpractical for hard work, than a cavalry soldier in marching order. He is over-burthened with things that he does not want on service, and his saddle has to be made unnecessarily strong and heavy to carry this useless weight. The man is taught in riding to keep his hands low, but the height of the kit in front, makes this an impossibility.

Saddles are fitted when horses are fat, and they do not fit when the horses grow thin. How can all this be avoided?

I would suggest the following plan:—

The valise on service should be done away with. The cloak should be rolled behind; and the man should not carry with him more articles than can be carried in the wallets. By carefully working out this system and lightening the saddle, which then becomes possible, we may take two stone off the weight of our cavalry, and we all know the immense difference this reduction would make in long marches.

I think that the substitution of leather numnahs for the felt ones now in use, would be an advantage, and the girth should be of web or plaited hide, which would save girth galls.

I regret that my time will not allow me to go more into detail upon these points, for they merit the most careful attention.

I feel that in a lecture of this nature I cannot pass over the subject of cavalry castrametation, and picketing.

The rules now extant as to the former appear to be useful and sufficient.

With regard to picketing, I think we ought to disabuse our minds of a great bugbear. When horses first go into the field after being in the stables they are unusually fresh and liable to break away from their lines. They then require special security. But when they have been in the field for a short time, they become perfectly quiet, and picketing becomes very simple.

The present method certainly provides for the first contingency, and is most useful in standing camps, but it is too cumbrous for use in presence of an enemy. Each man now carries a head and heel rope and one peg. The addition of another peg would make him perfectly independent of this cumbrous picketing gear, which might be carried in second line for standing camps.

And here another great question arises. Can tents be carried in first line by the cavalry of an army when in near contact with an enemy? I think not, but will state my reasons more at length hereafter, when discussing this as a question of tactics.

Having now discussed the main point of cavalry organization, let us consider the drill of the cavalry, and the question of what transport is necessary in the field to maintain a state of efficiency.

It is not my intention to open the question of pivot or non-pivot

drill, or to enter upon small details; let us consider this question of drill upon a broad basis; and one point is evident, viz.:—that we require more simplicity and, if possible, more accuracy and rapidity in the movement of large bodies.

At the present time we are hampered by restrictions which have disappeared from our infantry drill and from that of the cavalry and infantry of nearly all continental armies.

Our drill should more decidedly have the movements of war for its object.

It is all very well to say that fancy movements show the state of drill of a regiment and the quickness of Officers. This may have been very well in days gone by, but both the cavalry Officer and the cavalry soldier have now so much to learn that is absolutely necessary for the proper performance of their duties, that the time devoted to fancy drill, not applicable to war, must be time mis-spent.

Outpost and scouting duties, upon which in the future, the main value of cavalry will rest, demand constant practice and constant instruction. Yet, as was most justly remarked by a distinguished cavalry Officer in this room some weeks ago:—What opportunities have we for imparting this instruction? Few, I imagine, know the difficulties under which Commanding Officers of cavalry labour in this respect.

For instance, any one acquainted with the Brighton Downs, and also knowing that the head-quarters of a cavalry regiment was stationed there, would naturally suppose that great facilities existed for instruction in out-post duties. But on enquiring, they would learn that this beautiful country for cavalry is debarred from use, and that even a proper drill ground does not exist. It is the same almost everywhere. In the course of more than thirteen years of command both in England and Ireland, I can safely affirm that with the exception of Aldershot and the Curragh, no cavalry quarter that I have ever been stationed at, has afforded any fair opportunity for proper instruction. How easily might this be corrected by Act of Parliament, allowing this practice at certain seasons and paying a small compensation for damage.

Surely if it is worth while to spend so many millions upon our Army, these few hundreds need not be grudged when a question of efficiency is involved.

But this is not the only difficulty which presses upon a Commanding Officer of cavalry.

Every one must allow that the duties now thrown upon the cavalry soldier demand very much increased intelligence, and not only intelligence, but a knowledge of the operations of war.

It struck me many years ago, that this might easily be imparted to intelligent non-commissioned Officers and privates. Aided by a succession of active and intelligent Adjutants, I instituted classes where they received instruction in field sketching, reports on roads, and the whole theory of outposts, &c.

The men most thoroughly supported these efforts and many really attained remarkable proficiency. Their knowledge was also more or

less imparted to their comrades, and I soon discovered that a mine of zeal existed that only wanted working to become most valuable. But this instruction, even on a limited scale, entailed very considerable expense, and this expense was not borne by the public. I only mention this to show the many difficulties which beset a Commanding Officer of cavalry in carrying out a system of instruction that would really develop all the valuable qualities of both our Officers and men.

After leaving the question of drill, there is one point I feel I may here touch upon, and it is that of flag-signalling. Flag signals up to the present moment have not, I think, received the encouragement that they deserve. It is quite certain that we cannot trust to them entirely, but they are a most useful adjunct to an army in the field, and especially to light cavalry in advance. The system upon which flag signals have hitherto been worked at our Autumn Manœuvres is that they have been attached to the head-quarters of the army, and from the head-quarters a connection by means of signalling parties has been maintained to the front, where certain signalling parties have been placed. That system, I think, is a failure. Signallers should, it appears to me, be attached to the brigadier of the cavalry brigade which is covering the advance of the army. It must always happen that if attached to the head-quarters of the army they send back to the General in command, signals which do not correspond with the reports furnished by the Officer commanding the cavalry brigade. It is the part of the Officer commanding the cavalry brigade to sift the many reports which come to him from the outposts or from scouting Officers. He does not send each of these individual reports back to head-quarters; he carefully examines them, and, having examined the reports which come in from all parts, he is generally enabled to form a very accurate idea of the movements of the enemy. Let us imagine a case which might very easily happen. We will assume that the Officer commanding a cavalry brigade is covering the front of an army. From the reports which he receives from his different scouting Officers it is evident to him that the enemy to his front are massing on his left, probably with the intention of making an attack. On the right there happens to be a signalling Officer in connection with the head-quarters of the army. That Officer sees troops perhaps arriving from some distant point, and not likely to come into action that day. He sees these troops arriving on the right of his army, and immediately signals back to the General at head-quarters, "Enemy advancing in force upon our right." A few minutes afterwards the General Officer commanding the brigade, who knows of the advance of this division on his right, but knows perhaps that it has come from a great distance, and that its action will not be important that day, sends back a signal to the General Officer at head-quarters saying, "The enemy is advancing in strong force on my left; reinforce "me with infantry," I ask you what is the position of the General at head-quarters under those circumstances? He has two distinctly conflicting reports. It is possible he might say, "I must attach the "greatest importance to the report from the Officer commanding the "cavalry brigade," but at all events it would lead to indecision, and possibly to the reinforcements not being sent to the point expected by

the General Officer commanding the cavalry brigade, and might give rise to one of those difficulties which so constantly occur, and which are so important in war.

Before leaving this question, I will also touch upon a point which is attracting considerable attention. I allude to the question of Mounted Rifles. This is not by any means a new question; it is very, very old. The old dragoon was intended to be a mounted rifleman, that is to say, he was intended to be a cavalry soldier able to act either on foot or on horseback. During the American war, when cavalry had to be improvised, the whole of the American cavalry, on both sides, were organized upon the principle of the old dragoon, that is to say, they fought either mounted or dismounted. In the controversy which has taken place upon this point, I noticed a letter in the leading journal, from an Officer who served with the American armies. He called attention to the value of the American cavalry, as so organized. He called attention to the large numbers so employed, and he ended by saying that these American cavalry were, perhaps, of higher value than any cavalry that had ever been formed, belonging to any other army. Now, we can all look back to the American campaign, and, in looking back, what do we remember? We remember a series of battles, that were decided by the infantry on one side or the other, but which had no results, for they were never followed up. I ask, is it reasonable to suppose that, if cavalry existed which was superior to any cavalry that has ever been organized by any army, this, time after time, could have been the case? I think it is a manifest absurdity. Every Officer who has commanded any force of cavalry in the field, especially recently, must have felt the absolute want of mounted infantry—mounted infantry, not in large numbers, but in small numbers, attached to cavalry brigades. But I think, in considering this question, a distinct line should here be drawn. It is not mounted rifles that we want, to act as cavalry or infantry, but it is a small force of mounted infantry, to be attached to cavalry brigades; and we must remember that this force will be a most expensive one, because we find that, practically, when we use cavalry dismounted, we are only able to use one half, or the other half becomes immobile, that is to say, their horses cannot be moved in the absence of these men. Thus it would seem that we shall only be able to bring into actual use, one half of the force of mounted infantry that we maintain. That being the case, I think they should be men very highly trained, because it is an expensive force, and can only be kept up in very moderate proportions.

Before leaving the subject, which has been very ably touched upon by Colonel Wood in a recent lecture, I must say there is one point in which I disagree with what I think was his meaning. He spoke of carrying a proportion of these mounted riflemen upon cars, and proposed, as I understand, to use these men with the mounted men in advance of an army. This, I think, would be very dangerous. It is a most important point not to keep in front of an army, any carriages of any description that are not absolutely requisite. Nothing can be more important before an action than that all the roads which lead to the front should be kept perfectly clear for the infantry that are

coming up. We have only to assume a shot striking some of these cars, the men could never get to the rear again, they would have to be left in the hands of the enemy; and it is very easy to assume, when these cars were driven back, that they would fall back occupying important roads, which ought certainly to be left clear to the troops coming up.

Let us now pass to the consideration of the amount of transport which is necessary to maintain a cavalry regiment effective in the field as an integral part of that regiment. I say an integral part, for I am quite sure that this meeting will support me in advocating regimental, as opposed to general transport. But when we consider the organization and amount of transport, some very large questions arise. Officers are generally too apt to ignore these large military questions, and to look upon the amount of transport as it affects the convenience and well-being of their own particular regiment.

I think I can soon prove to them that this is a mistake, and that we are all bound to exercise the greatest economy, and to make the greatest sacrifices in this respect.

When armies are not likely to come into contact with an enemy, the amount of transport within ordinary limits is not of any material importance, for armies, under these circumstances, usually occupy a very considerable front, and move by very many different roads. But when these armies are likely to come into contact, a totally different state of things prevails. The front is diminished, and the few roads by which the army can march, are blocked with long columns of troops. Let those whose experience is limited by the Autumn Manœuvres remember the length of the transport column of even one brigade of cavalry, and let them picture to themselves a transport train organized upon that scale, with possibly even a whole *corps d'armée* marching upon one road. Under such circumstances, the transport would be perfectly useless, for the depth of the column alone would prevent its ever coming up at the end of the day.

Moreover, the cavalry would usually be acting in front of the army prior to contact.

If immediately followed by heavy transport trains, imagine how the roads would be blocked for the main body of the army coming up, perhaps, when it was most important that its movements should be free and unimpeded. It will, therefore, be evident that, when advancing to meet an enemy, Spartan simplicity must prevail, and the use of tents becomes impossible.

It is constantly even impossible to feed an army, by means of transport, just prior to contact, unless it is actually in line of battle, and it should be an absolute rule that, under these circumstances, men should carry at least two days' rations with them, and horses one day's forage.

Nothing should be more severely punished than the act of men consuming their rations before the proper day. Rations, under these circumstances, should be inspected as carefully as ammunition, for they are still more important.

But, even when regimental transport must be kept to the rear, it is advisable that one day's supply of corn should follow each cavalry

brigade. Two waggons will carry a supply of oats for one day's consumption of a regiment. This is better than overloading horses with corn, but those having care of the waggons must be charged to clear the roads, at any cost, in case of artillery or infantry coming up and requiring them.

Before leaving this question, I will turn to one nearly akin to it, and which should be carefully considered by the cavalry Officer; I allude to the supply of water on service. The efficiency of cavalry horses depends, to a great degree, upon their being properly watered. They should always be watered twice a day. In selecting cavalry camps or bivouacs, they should, if possible, be placed close to the water. Staff Officers, unacquainted with cavalry, are too apt to ignore this; they imagine that two miles from a watering place is a comparatively unimportant distance. They forget that this entails each horse travelling eight unnecessary miles in the day, in addition to his other work.

I will now turn to the general tactical action of cavalry during a campaign.

I propose to deal with this question by imagining the operations of an army in the field, and tracing the possible and probable action of the cavalry attached to, and accompanying that army.

It will be sufficient for our purpose to-day, to limit this force to one *corps d'armée.* Here, at starting, a tactical question of some importance arises.

Assuming that the proportion of cavalry to a *corps d'armée* would be six regiments, how should these regiments be distributed? By the old Prussian system a regiment was attached to each infantry division of twelve battalions, and the remaining four regiments worked in two brigades of two regiments each. But during the late war, it was found that these regiments attached to divisions had little or nothing to do, and that when a large force of cavalry was required in the front, an unnecessary portion was thus frittered away; and it is now generally considered in the Prussian Army, that although a certain force of cavalry should distinctly be attached to each division, a regiment is an unnecessarily large force for this purpose.

I believe the Prussians have now decided upon attaching a wing of a cavalry regiment to each division, which will give one cavalry regiment attached to a *corps d'armée.* The wing so attached, of course becomes distinctly under the orders of the Generals commanding divisions.

But although, I thoroughly coincide in this view, and this for reasons which I shall state and try to prove hereafter, I shall assume that the organization of our force will be that of three divisions of infantry of seven battalions, each having a cavalry regiment attached, and that a brigade of cavalry and horse battery will remain distinct.

Now let us first trace the usual action of armies on a declaration of war. Firstly, the line of operations has to be determined upon. Then the two opposing armies are assembled at a very considerable distance from each other. Up to this time intelligence is derived from spies. A little previous organization and good pay makes it easy to obtain general information as to the line of operations selected.

But already the action of cavalry has commenced. Far in front of the assembling armies a screen, thin and weak perchance, but still a screen must be immediately drawn.

It is impossible that this can be done by infantry, although small infantry posts in support are sometimes important. It may be that a hundred miles of frontier has to be so watched.

And here, at the outset, we come to the distinction between outpost duties as ordinarily understood by us, and laid down in the regulations, and the scouting duties I am now alluding to.

For it is evident, that to maintain a line of 100 miles upon the ordinary system of outposts, would require an immense force of cavalry, whereas a screen of scouts might be formed from a very moderate force.

It will be well at once to draw what I conceive to be the real distinction between the two.

Cavalry outposts proper, are usually placed when armies are in close contact.

Scouts, on the contrary, generally act far in advance of the armies to which they belong, or on an enemy's flanks, or for special purposes when armies are nearly in contact. Outposts are maintained for protection from surprise. Scouts are used for gaining information.

It follows necessarily that scouts should be selected for extreme intelligence.

The value of good information is so important, and the evil of bad information so great, that it would never be safe to trust to any body of ordinarily-trained men to fulfil these duties. Having been previously specially trained, they should be specially selected from each regiment and placed under an Officer, remarkable for his energy, quickness, coolness, and decision : a first-rate Officer of scouts—a man whose information can always be relied upon,—is invaluable to an army. Never did knights of old unite cool courage, daring intrepidity, and fine horsemanship in a greater degree than must be combined in him. And to these qualities he must add a thorough knowledge of the organization of armies and a practical acquaintance with the operations of war. His men will quickly recognize these qualities, if they exist and will work up to him as a good pack of hounds will work under a good huntsman.

It remains to be considered what number of scouts per mile will usually be sufficient for an army under ordinary conditions of country. I think that ten scouts per mile would be a maximum number and five a minimum. And here let me confess that I intend to advocate a novel theory in the action of cavalry. I may be right or I may be wrong, and I invite full discussion on the point. I believe that we and most countries are in the habit of frittering away our cavalry in unnecessary small bodies, which can never be brought together in time to oppose a determined reconnaissance on the part of an active enemy, and in place of this system, I would advocate a thin line of intelligent scouts aided by signalling parties, this thin line being supported some distance to their rear by bodies of cavalry massed in considerable numbers, say a brigade with its guns.

When armies are not in near contact, I believe this system to be immeasurably more effective than having chains of vedettes with picquets and supports, and it saves both men and horses.

But let us now start with our *corps d'armée* at the commencement of its operations. At about forty or fifty miles, or two days' march, in front of this main body the line of scouts will have been established. This line, selected from each regiment in the brigade, will perhaps occupy an extent of front of from ten to twelve miles.*

It is advisable that an intelligent Officer of scouts should be posted to every three or four miles. To every five or six miles, a supporting squadron should be placed some five or six miles to the rear of the line of scouts. These squadrons should keep up a communication with each other by patrols. About ten miles to the rear of these squadrons, and in a central position, the brigade should be massed, and in telegraphic communication with its corps.

Between the brigade and the squadrons, orderly posts will be established; and here, at the outset, we see the disadvantage of having so much cavalry attached to the divisions; for now, when cavalry are so much wanted in the front, three regiments would be with the *corps d'armée* doing nothing. It would probably happen that they would be sent for in support of the cavalry brigade; but, if so, could we be sure that they would come up in time, or afterwards rejoin their divisions at the proper moment, and would there not be a clashing of commands? It is scarcely needful to say that this line of scouts, the supporting squadrons, and the cavalry brigade would all be in advance of any line that it was considered necessary should be held by the *gros* of the *corps d'armée*, in order that time may be given to it to advance and take up its line of battle before an enemy could possibly arrive there.

The value of this system, I conceive, would be great. I should urge that where it is possible, for it will not be always possible, the cavalry of an army should be pushed very far to the front, and that the scouts should be pushed very far in front of the cavalry, and the reason is as follows. If the enemy attempt to drive in your line of scouts at any point, they have to advance a very considerable distance before they meet with your brigade or your mass of cavalry. In the first place they would arrive more or less exhausted, and in the next place you would have had information of the point and direction of their attack, and it would give you time to make such arrangements for meeting them as were requisite. This, I think, is a point which we might all study. I only urge it as a theory, and it will be for the meeting to discuss it as they think right, and to give it its proper value.

Next in order, I think, we must consider the moral effect that would be produced if we only allowed one brigade of three regiments to act in front of our *corps d'armée*. We all know that moral effect is of the greatest possible value in war. It is especially of value at the commencement of a campaign, because troops are more or less acted upon in *morale* by the first affair of any scale between tolerably even parties

* It is of course supposed that this *corps de d'armée* is supported by others on its right and left.

of the contending armies. Supposing that we maintain the system of a distinct cavalry brigade of three regiments acting to the front, leaving three regiments attached to the divisions of the corps, it is quite evident we shall only have three regiments available in front. Assuming the organization of the Prussian *corps d'armée* they would have but one regiment attached to the infantry, and they would bring five regiments to the front. I think that this would place us at a very considerable disadvantage, and it is a point that is worthy of thought and discussion.

I shall now turn to the question of cavalry attack, and in doing so I shall first touch upon the attack of cavalry upon cavalry. We all know that it is our custom, and for purposes of drill it is very useful, to manœuvre cavalry in large masses and very long lines; but those who have had experience in war will, I think, bear me out when I say the opportunities for using these long lines, very rarely occur. I have asked a great many Officers who were engaged both in the Austro-Prussian, and in the late wars, and I myself had some opportunities of seeing them in action in the late war, and I must say I never saw cavalry used with a very large front. The front of a regiment is usually about the extreme. But we have to make general arrangements for the attack of cavalry upon cavalry, and it is upon those arrangements we shall now touch.

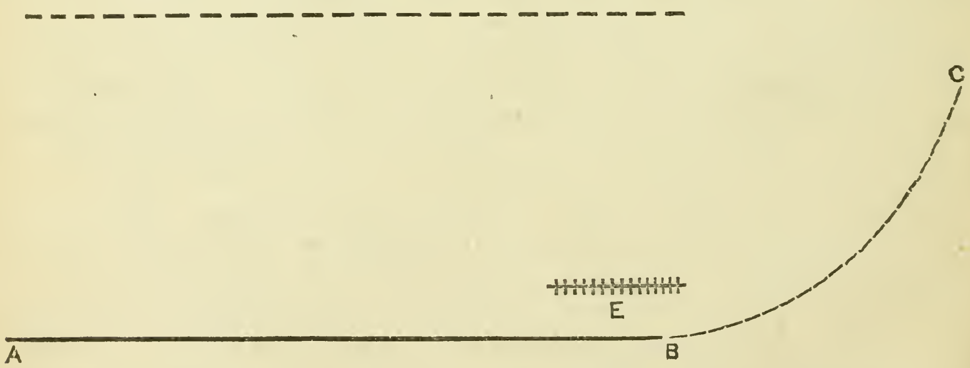
There are three general ways of using cavalry against cavalry. Firstly, the attack in open column; that is to say, the attack of a body with another body immediately in support, and another body immediately in rear, in reserve. This has very generally to be used, but I think everybody will see that it is open to the objection that if the leading force is driven back, it is very apt to disorganise the forces coming up; therefore I think all cavalry Officers will bear me out that it is not a convenient or good mode of formation if it can be avoided. Next, we have the attack in echelon, and this, for all practical purposes, is most generally useful. It may be either in echelon from the right or left, or echelon from the centre. The mode of attack I should usually advocate would be echelon from the centre. There is another mode of attack which is certainly most useful if intelligently carried out: it is the attack by means of oblique formations on either flank. This demands considerable intelligence on the part of the Officers commanding regiments or squadrons, but it may be most effective.

We now come to the attack of cavalry upon artillery. It must be acknowledged that, with the great power the guns now possess and the destructive effect of shrapnel, cavalry must not show themselves in bodies, more than is absolutely necessary, within range of the guns. But it may constantly happen that it is necessary for cavalry to attack, and if possible, to drive in batteries of artillery, for if cavalry can only make a battery limber-up for a time, they may do inestimable service. I should propose that one troop of cavalry should be extended in skirmishing order, supported by another squadron with open files, and that they should advance rapidly upon the guns. They thereby place the guns in this position:—we know it is a special rule with artillery that they do not, except under special circumstances, fire at skirmishers,

and they would not know what to be at. I think that this leading line of skirmishers should be taught, when getting near to the artillery, to close rapidly upon the battery, and to endeavour to shoot the horses. The artillery would be probably supported, but, if their supports advanced, they would be met by the sudden closing-in of the open files in support of the skirmishers. I have tried this system and it appears, as far as one can judge in peace, to work very well, and artillery Officers have told me they thought, in all probability, it would compel their batteries to limber-up for a time.

I shall now come to the action of cavalry against infantry. I think we must assume that cavalry will not be able to act successfully in the future against steady infantry in thorough formation. But there are opportunities when cavalry may be useful; and what I should hope to see introduced would be, that there should be a squadron attached to every seven battalions, and one squadron to the head-quarters of the corps; that these squadrons should lie hidden at about every half mile. It will constantly happen that, when the infantry advance, one side or the other will generally give way. If we suppose that our own infantry give way, a cavalry squadron that can be launched upon the enemy's infantry may often be most valuable, and all those who have seen war know, how very often a momentary success becomes important. Troops retire more quickly than is expected, the enemy encouraged, follow more quickly than would be anticipated, and a gap is suddenly made in the line of battle. I think, therefore, that cavalry squadrons, detached at intervals, will be most valuable.

We now come to the action of cavalry in general line of battle. I think that the action of the *gros* of the cavalry will usually be upon the flanks of an army, but the attack of armies in the future must, I conceive, consist either in turning a flank or piercing a centre,—I think, in a greater or lesser degree, it will resolve itself into that. Assume an army turning a flank. Consider that this diagram from A to B is a



general line of battle, and assume that this army has determined to turn the enemy's left flank. Under modern conditions we know the great power of the defensive, it will therefore probably leave a very weak force to maintain the line from A to B, and it will move round the enemy's flank, concealed, if possible, in the direction of C. If it does so it is evident it will probably mass the majority of its guns upon the

point E, because if the guns are upon that point, the moment the movement is made, the enemy must necessarily throw back his flank to meet it, and if he throws back his flank to meet it the guns enfilade the whole of his new line. It will be necessary that a great part of the cavalry force shall be upon this flank, because we must suppose that the enemy's cavalry will be upon his flanks, and that all armies will throw out a line of posts to prevent any such turning movements being made by surprise. It is evident the cavalry will first of all have to drive in these scouts or cavalry parties, and so enable the infantry to move up to the flank and to make their attack. With regard to piercing the centre, I think the action of cavalry would also be upon the flanks. I have been compelled very much to compress these latter remarks, and I fear they will not in consequence be very clear.

But the clock warns me that my allotted time has drawn to a close. I fear I have touched very cursorily and imperfectly upon this most important subject, but, before concluding, I trust I shall be forgiven if I urge upon all young cavalry Officers the absolute necessity of their appreciating the responsibilities of their profession.

I have endeavoured to show that so far from this arm losing its importance in war, its value is daily increasing.

But that value must depend upon the energy and the knowledge of military operations to be found amongst its Officers.

Accept then, I say, the altered *rôle* which is imposed upon our arm. Shall we regret a change that so clearly brings out all the fine manly qualities of the early training of the British youth? Shall we regret a change that gives such scope to individual intelligence and daring?

No, let it ever be our earnest duty to develop all the advantages that have been accorded to us, and to render the cavalry of England fully fitted for the work that may some day devolve upon it.

The CHAIRMAN: Gentlemen, having heard this excellent lecture of Colonel Baker's, several here may wish to offer remarks upon it, and I will, with your permission, say a few words. Colonel Baker has advanced a great many admirable theories, which it is not very easy without due consideration to answer; but there are one or two points which I should wish to remark upon. One is with regard to the difficulty of procuring horses. It appears to me, from what I have heard, that the number of horses in Great Britain and Ireland at present, is greatly in excess of what it was some twenty years ago, and that, therefore, no difficulty should be found in fully supplying the Army. Want of money is the great drawback. The cost of horses has so greatly increased that in order to procure horses, Government will be obliged to pay an increased amount for them.

In India, you are aware, they have studs at different parts of the country where they breed horses for the cavalry and artillery. These studs have no doubt been found expensive; but seeing the great and increasing prices horses are fetching, it might be advantageous to establish them in this country. The price a horse costs Government, at four or five years of age, is, I understand, £65, and this cost will, I fear, increase. But at the same time, if Government will pay a high price, as many horses as the Army can require, may easily be obtained.

Then with regard to "mounted riflemen," I heard Colonel Wood's lecture* the other day, and though I admired much of it, there were some points with which I did not agree. I concur in Colonel Baker's remarks regarding carts for this force. I think it

* "Mounted Riflemen," by Lieut.-Col. Wood, V.C., a Lecture delivered at the Institution to Officers of Volunteer Corps.

would be very injurious to the service if any such conveyances were used. Such a scheme would be utterly impracticable. Now-a-days wars are of such short duration, that I am of opinion that even conveyance for tents will have to be dispensed with, and soldiers will have to bivouac. I am induced to consider that these mounted riflemen should be at once established, but they should be a totally independent force, neither cavalry nor infantry. I would rather, however, form them out of the cavalry, because I consider the recruits now-a-days in the cavalry a rather more intellectual class than those in the infantry, they would therefore be better instructed in horsemanship, and understand better the management of their horses, and would soon learn to be good shots. This force I would chiefly employ to escort artillery, and to protect them in taking up positions. My idea is that for a force of 5,000 cavalry there should be 1,000 mounted riflemen, or with a division of all arms, 500.

One other point I should wish to remark upon is the cuirass mentioned by Colonel Baker. No cuirass can resist a shot directed straight at it, but if it is a slanting shot a very slight resistance will turn it, and I should be inclined to consider the light cuirass would be sufficient.

Lieutenant-General Sir PERCY DOUGLAS, Bart.: I must apologise for taking any part in this discussion, never having served in the cavalry, but there are one or two subjects on which Colonel Baker has spoken, in which I have taken very great interest. In the first place I was delighted to hear in his admirable, thoughtful lecture, that Colonel Baker recognised the great truth that the duties of cavalry will be greatly extended in future wars, and that the area of these extended, and wider field duties, must bear some definite proportion to the weight the horses have to carry. It has been a subject of serious thought to many people, and amongst others to myself, how the weight upon the cavalry horse can possibly be reduced. My experience in this direction has principally been at the Cape of Good Hope, when I had the Cape Mounted Rifles under my command, and I had also under my constant observation the Cape armed police. I observed that these mounted police carried everything necessary for horse and man, and that they travelled immense distances over frightful roads and in very bad weather. I inspected these men after marches of 200 or 300 miles, and I never saw a sore back amongst their horses in my life. It then occurred to me to weigh the equipment, and I found it was something very near what Colonel Baker has said to be possible—viz., that it was about two stone lighter than the marching order equipment of the Cape Mounted Rifles. The two forces were thereby placed in this position, that the armed police accomplished work in a month, that the Cape Mounted Rifles could not have accomplished in six weeks. I had patterns prepared of the equipment and sent them home to the Horse Guards some eight years ago: whether these exist in the stores there I know not, but I firmly believe, as Colonel Baker says, that by its adoption, the cavalry equipment can be lightened at least a stone and a-half, and you would still have as good a saddle as the much-vaunted English cavalry pattern. Thus one of the first objects of the cavalry, the lightening the load upon the horse, may be accomplished, and I am glad to see that men of Colonel Baker's wide experience and knowledge are taking this question up.

I was very much pleased to hear from our lecturer the admission of the principle, that mounted infantry are a useful force, and I hope that this is now a mere question of degree. Our gallant Chairman has taken what I was going to say out of my mouth, for the truth of the matter is, one great use of mounted infantry will be, the escort of guns. The escort and the defence of artillery by mounted riflemen will lighten the duties which now devolve upon our very small and attenuated cavalry force. When we come to consider the present aspect of the artillery question, I think you will see the force of this. Our field batteries are now *quasi* horse artillery; they move with rapidity; arrangements are made for carrying upon the limbers, men enough to work the guns, and in fact they did, during the recent operations in Wiltshire, move with the facility of horse artillery. When we consider the immense range of the guns, the great distance they must be at from the solid protection of the infantry of the line, and the independent action accorded to batteries, it is most important that these guns should be properly protected by military escorts. The performance of this duty by infantry is no longer possible, and my opinion is, that no body could afford so efficient a protection to artillery as a specially well-trained mounted infantry force: that is one main object we should have in view

in considering the cavalry question. I am glad to hear that this is admitted in principle, and that it is now only a question of degree. Sir Hope Grant has suggested a certain proportion of mounted infantry. I do not do that at present. Our lecturer has in his very able lecture, divided the consideration of the subject into two parts, offensive and defensive operations; defensive operations meaning the protection of our own soil. Of course in the defence of the country, the auxiliary forces, the Militia, the Yeomanry, and the Volunteers enter very largely, and, I would ask, to what more useful purpose could we turn our Yeomanry than in making them good "mounted riflemen." Good cavalry they certainly never will become. I shall say no more, and I apologise for saying so much. What we want is diminution of the weight upon the horses, and I believe this to be possible nearly to the extent that Colonel Baker says, and it would not be difficult to estimate what would be the widened area of cavalry operations, if nearly two stones' weight be taken off the horses' backs.

Major Knollys, 93rd Highlanders: The lecture given by Colonel Baker has been so exceedingly suggestive, and so short a discussion has taken place, that I trust I may be allowed to make a few remarks. Though, as an infantry Officer, I have had no practical experience, yet I have given a great deal of thought to the subject. I was very glad to hear Colonel Baker say what he did about the mounted rifles, especially with regard to the American war. I always understood the reason why the American horsemen were organised as mounted riflemen was because they had neither time, arms, nor equipment to turn them into cavalry, and I was glad to hear Colonel Baker point out the utter absence of all strategical results from the battles; this, no doubt, was due to the want of an efficient body of cavalry. It has been said by some writers in the papers, that if a body of mounted riflemen came across a body of cavalry they would have to run away, and would be at their mercy. Now I am not quite clear that the boot would not be on the other foot, and that the mounted riflemen would not be in their position, and cannot suppose that any cavalry Officer would allow the rifleman quietly to alight, to get under cover to attack him. On the contrary, I believe he would amuse them in front, and would make an attack upon their vulnerable point, namely, their horses. I think it would be a very desirable addition to the mounted riflemen if there was also a small body of mounted engineers. Very frequently it is requisite to send a body of troops on in advance, to occupy and fortify a defile, or to blow up a bridge, or restore the communication over it; and if a body of mounted riflemen, accompanied by a body of mounted engineers, were sent on such duty, I cannot but think that they would prove most useful. These troops would also be valuable for another purpose—that of carrying succour rapidly to outlying portions of a line of battle. A few days ago a most graphic account was given to me of the doings of the camel corps at the battle of Calpee. There was an outlying redoubt, defended by a small body of infantry and artillery. Three regiments of the revolted Gwalior contingent proceeded to attack it. As soon as they gained the top of a little swell of the ground, they fired: they descended into the next ravine, loaded, and as they passed the top of the ravine, fired again. In this way they advanced by degrees, keeping up a most tremendous fire on the battery, and disabling most of the gunners. At last they came so close that the Officer in command said, "You must draw your swords and do the best you can." At that moment up came two companies of the 80th and two of the Rifle Brigade on these camels. Down went the camels, off went the men, who, without waiting to form, fixed bayonets and dashed at the foe, who looked paralysed, and made for the rear as fast as they could.

Then, with regard to cavalry in the line of battle, apart from the cavalry on the flank, I cannot but think an immense amount of use may be made of them, if they are employed in very small bodies, and distributed along the line, to be kept under cover till the moment they are wanted. In such a case, each leader of a squadron must have the same independence of action as the commander of a battery: for the opportunity would be short, and, unless he seized it at once, and without waiting for further orders, the opportunity would pass away. Colonel Baker said, and everybody admits, that cavalry would have very little chance against unbroken infantry; but there are occasions when we have an opportunity of coming suddenly on infantry, and on those occasions I think that we may inflict great loss. I remember the last

day of the first Autumn Manœuvres, at Foxhill, seeing the Bays come suddenly over the brow of a hill, upon a body of the 42nd skirmishers. Their attack was so unexpected that the 42nd were completely surprised, and, for a moment, they hardly knew what to do. If they had been in action, the cavalry would have been amongst them before they could have recovered their surprise. Also, during the last Autumn Manœuvres, I observed, along the banks of the Wiley, numerous little spurs and ravines, where squadrons of cavalry could have been concealed and kept ready to let slip at the right moment, on many occasions, with the greatest advantage. They could have dashed out when least expected, and have been back under cover almost before they could have been fired at, I think that would have had a most unsteadying effect upon the enemy's skirmishers, as I am sure the possibility of cavalry being behind every swell of the ground, would have a most demoralizing effect upon any enemy.

Colonel Duncan Baillie, Royal Horse Guards: There is one suggestion that I should like to make. Colonel Baker rightly proposes that the number of men, in every cavalry regiment, should be largely increased. If any serious disaster occurs to our cavalry in war, either from illness or any other cause, we have nothing to fall back upon—we have no reserve, of any sort, except the new reserve which has been formed, and of which we know very little; and I would suggest, whether it would not be advisable that a militia cavalry should be formed in this country, the men being taken on the understanding that, in time of war, they should be appointed to the regular regiments of the Army. A depôt should be formed, with a certain number of horses, say 200 or 300, where these militia might go through an annual course of training, and the new reserve should be trained every two or three years, at this same depôt. We might then have a certain number of men taught to ride. At present, if anything happens to our cavalry, which is very weak, we have nothing to fall back upon, and I am afraid, in a long campaign, our cavalry will entirely break down.

The discussion was then adjourned to Wednesday, March 26th.

Wednesday, March 26th, 1873.

General Sir JAMES HOPE GRANT, G.C.B., &c., in the Chair.

Adjourned Discussion on Colonel Valentine Baker's Lecture on "Organization and Employment of Cavalry."

Colonel Goodenough, R.A.: Sir Hope Grant, I have prepared a few notes, amongst other things, upon the Horse-Conscription-Law of Austria, which was passed about a year ago, which I thought it would be interesting to the meeting to hear about, and with your permission I will read these notes. By the above law, the whole country is divided into Levying Districts, and one or more central places of reception are appointed for each. Every year, the War Department communicates to the civil authorities the number of horses which would be required to be found in order to complete the army from the peace to the war footing, on the basis of the existing organization, or *ordre de bataille*. On the basis of this information the Minister of Agriculture, who is aware from reports annually received through the district-prefects from the chiefs or overseers of parishes, of the number of horses of different classes to be found in each district, which are also classified according to their probable fitness as riding, draught, or pack horses—the Minister, I say, apportions to each district the number of animals it has to furnish. At the commencement of each year, commissions are appointed to each levying district, consisting generally of the civil prefect or his deputy, a field or other officer of the army or landwehr, and a veterinary surgeon, whose ultimate duty it is to pass horses into the service. Each commission is assisted by three sworn valuers, experts, chosen, if

possible, from agricultural or other societies. On a mobilization being ordered, the War Department announces the number of horses required and the time when they are to be delivered, and the civil authorities summon all owners to bring their horses over four years of age, to the Levying Centres. Certain horses are exempted from levy, such as those belonging to the Imperial Family, or which servants of the State or postmasters are obliged to keep to perform their duties, those belonging to public breeding establishments, also all licensed stallions and brood mares certified as such. The passing the horses into the service then begins; those are first taken which the owners are ready to part with for the ordinary remount-price about £25; the remainder are inspected, and those which are adjudged fit for service are valued by the valuers attached to the Commission, and this is done without reference to the remount price, or to the possibly temporarily enhanced prices occasioned by the mobilization. The horses valued, are then passed into the service, commencing with those of the lowest judged value, and the owners are immediately paid their price in cash. Any owner of a horse not yet branded, but passed in, may replace such horse by another serviceable animal of the same category. There are, of course, penalties for non-compliance with the law. To lighten the burden of this forced levy, the parishes of a district are permitted to avoid compulsory furnishing of horses, by voluntary presentation of their proper contingent from their own district. In this case they are paid the remount price augmented by 10 per cent.; but the horses must be produced within 48 hours of the receipt of the order to furnish. Whilst the levy is going on, the owners must keep their horses at their own expense; but the Government Officers must not detain the horses over 48 hours at the Levying Centres. Thus, if everything is in order, it may be estimated that the War Department would be in possession of the horses they require at the Levying Centres within 96 hours (four days) of the receipt there of the order to furnish them. It is worthy of remark, that the major part of the horses thus to be furnished, would be destined for artillery or transport purposes, as the cavalry regiments, 42 in number, are kept up during peace to their full field strength, six squadrons of 150, or 900 horses each, to which is only added on mobilization, a first and a second reserve squadron.

The arrangements in force in the Hungarian honvéds or landwehr,—which forms almost a separate national army by itself,—for keeping up a reserve of horses, are worthy of note here. In the Hungarian honvéds, the plan proposed by Colonel Baker for the formation of a reserve connected with the Yeomanry has been actually in force for about three years; there are about 32 squadrons of cavalry belonging to these honvéds, each of which keeps up a permanent cadre for purposes of training men and horses; they buy annually a proportion of horses in excess of their fixed peace-strength, and keep them at head-quarters till trained; after training, the horses are given out to farmers or peasants who engage to keep them in good order, subject to giving them up for use when required; they are inspected occasionally; and after they have been thus in the farmer's charge for about eight years, they become his property. I have myself seen these horses when called out for manœuvres, and I believe that the system has worked well up to the present time. I think Colonel Baker's suggestions in reference to the formation of such a reserve as this most valuable; for, though we have no such civil organization as prevails on the Continent, and our farmers would not like, perhaps, to be brought into direct connection with military authorities, yet the old established and popular Yeomanry organization would seem just calculated to supply the necessary link between them and the regular cavalry. The staff of a Yeomanry regiment would undertake to provide for a given number of reserve horses, and could without difficulty act as the go-between between the cavalry regiment or depôt, and the farmer who actually takes charge of the animal.

There are also some points with regard to the Austrian cavalry which I thought might interest the meeting as bearing upon this subject. One of the provisions for the composition of an Army Corps—it is a small point, but I think, a very important one—is, that attached to the head-quarters of each *corps d'armée,* irrespective of the strength, or the particular organization of the portion of cavalry which may be attached to that *corps d'armée,* there is always a cavalry general with a brigade staff, unattached, but ready to undertake any special cavalry duties, or to command the divisional cavalry on occasions of its being massed for special purposes.

With reference to the subject of Mounted Rifles, I would like to say that in the Austrian cavalry, the men are regularly trained to act dismounted, though perhaps an objection might be taken to their mode of action, as they habitually leave only one man for the charge of about 10 horses, so that these are immobile. This regulation, however, is obviously subject to modification in view of the immediate nature of the service. The highly talented Austrian Minister of War, Baron Kuhn, has strong opinions in favour of the employment of mounted infantry, and he recently told me that it had been his intention, when a mobilization was contemplated, to mount some six battalions of Jägers for employment in this manner. Baron Kuhn is as much against the mounting of infantry on cars, being of opinion that the multiplication of wheeled carriages with an army, is by all means to be avoided as they sacrifice its mobility. Without reference to the material of the Austrian cavalry, I have the highest admiration of their system in equipment, drill, and training, and spirit. Considering the difficulties they have to encounter in their scattered village quarters, the results they accomplish may really be called astonishing, and I only wish that more Officers of our service would bestow the attention on their system which it deserves. As to equipment, they have no valise ; the cloak is carried behind the saddle, and the kit in the wallets in front ; the men carry their light carbines strapped on their backs ; a section (division) of one squadron is equipped with pioneers' tools, and two or three men in every squad of ten carry that most useful article a canvas water-bucket, calculated to facilitate in a high degree that most important operation of watering, on which our lecturer laid such deserved stress. Adverting to the action of cavalry during engagements, and to their being prepared for attacks on the enemy's batteries, or raids at other times on his train, when the rapid shooting down of the enemy's horses would be so important, I would like to suggest the question whether such services could not be much better performed, if a proportion, at least, of the men of each squadron were armed with a good repeating-rifle. If this arm is ever to find a place it would seem to be in the hands of a mounted man, who is necessarily impeded in the operation of reloading.

One of the features in connection with the Austrian cavalry is, the organization of the so-called field-gendarmes, whose duty it is to aid the staff, acting as assistants to staff-officers in marches in laying out camps, and in reconnaissance, in scouting duties and in the collection of intelligence. They act also as field police, and are employed in what are commonly called ordnance duties, and in the scouting service generally. The men are selected in the proportion of about two from each infantry regiment. or three from a cavalry regiment, every year. They are collected together under Officers who would afterwards be attached to them, and they are all trained together. They do not wear any special uniform, but are distinguished by a red cross belt. I bring forward these particulars as of interest in connection with what the lecturer has told us as to the duties of the cavalry in scouting—that service which we may best know by the name of scouting as distinguished from the ordinary out-post service. There is no great number of these men. The total number for the army is 330 mounted and 450 dismounted men. Each division has only about four. Each army corps about 20, and each army would have about 100 such men. I mention that in order that no exaggerated opinion may be formed as to the numbers of this body.

Captain Trench, 20th Hussars : I am very glad that in the lecture which we had the pleasure of hearing last week, Colonel Baker dwelt at some length on the importance of effecting a thorough reform in the whole system of our cavalry equipment. I am afraid, however, that the past history of this question is scarcely calculated to encourage even the most sanguine of us in the idea that any reform is likely to take place for a long time to come. For what is the history of this question ? What are the real facts of the case ? Notwithstanding all that has been most strongly urged by cavalry Officers for the last five or six years, and notwithstanding that we have had within that time two continental wars,—one, so to speak, almost at our very doors—which have illustrated in a remarkable degree the increased demands which are made in modern campaigns on both men and horses, this question, in the English cavalry for the last quarter of a century,—and, I say it without exaggeration,—has almost stood absolutely still. The English hussar and dragoon and his horse are

still doomed to carry the same cumbrous paraphernalia of luggage; he is still bedecked and bedizened with the same list of heavy, and in many cases entirely useless articles, which it has been the fashion to hang upon him and his horse for the last twenty-five years. Every now and then, by way of a pretence, I suppose, of doing something, some little alteration is made, and it would seem as if we were going to make some real progress in this question. Occasionally, for instance, a saddle weighing perhaps two or three ounces less than the present one in vogue is experimented upon, or the hussar gets rid of the necessity, say, of carrying a collar chain, or some equally useless piece of lumber which it has been so long the fashion to hang either upon him or his horse, that it has become considered in some quarters almost a sort of sacrilege to attempt to lighten him of any of it. As far as any real attempt to grapple with the question and to solve the problem, how to lighten the burden carried by man and horse, no practical effort in the English service has ever really been made. Every unprejudiced cavalry Officer, I think, must agree with Colonel Baker when he states, that it is difficult to conceive anything more unpractical than the present mode of equipping a cavalry soldier in service-marching order. From time to time we hear, as I have said before, that a great deal is going to be done. We heard so in 1866. We heard so more notably still after the war of 1870–1871. Outsiders—and by outsiders I mean regimental Officers—have all heard of committees that have sat to report on this question with a view to a thorough reform being initiated. These committees have nearly all been composed of some of the ablest and most favourably known Officers in the mounted services, and I have no doubt that if the many valuable suggestions that have doubtless been made by them in the course of their duties had been carried out, not only would a reform have been initiated, but it would have been perfected and carried to an end long before this. Often in arguing this point one is met on the part of Officers who are strictly conservative, and who are so wedded to the old state of things that they do not like to move, by the argument that the English cavalry soldier in this respect is no worse off than his continental brother, and that the French, Austrian, Prussian, or Russian hussar carries just as much (which is, perhaps, true enough) as his English *confrère*. I think that this argument is one of the most poor, and at the same time most humiliating that it is possible for an English cavalry Officer to use. It is equivalent to saying that the English cavalry is always to follow tamely in the wake of continental imitation, and is never to lead the path in the way of progress and reform, but that we are to continue in the old groove of continental and notably German imitation, which has so long been the curse and bane of the British cavalry. A most remarkable point in this state of affairs is, that though every one acknowledges and deplores the existing method of equipment, and though Colonel Baker, like many other Officers before him, has pointed out how it may be altered and improved, nothing is ever really done to remedy it. Though our service has advanced far enough in many respects, as every one knows, since 1870, that is, within the last two years, the British cavalry, in the question of cavalry equipment, would have seemed, I might almost say, to have nailed the motto, *quieta non movere*, to its colours. I still hope something will be done, but having been some fifteen years in the service, I confess that I am getting very sceptical upon the point. It is almost a truism, perhaps, to say, that to bring your horses and men as fresh and as little over-burdened as possible into the field, is one of the first elements of success in cavalry operations in modern warfare. But in our service it would almost seem to be lost sight of, that this element of success may, like any other, be squandered by a too rigid and antiquated adherence to obsolete methods of equipment, which ought long ago to have been regarded as mediæval curiosities, and, as such, relegated to the walls of a military museum. At any rate they should long ago have been discarded by us in deference to the requirements of cavalry in modern warfare.

Mr. CLIFFORD WALTON, Deputy-Assistant Commissary-General: It is with very great diffidence that I address this meeting at all, because I am not only not a cavalry Officer, but also the branch of the service to which I have the honour to belong, may very reasonably be presumed to have no very intimate acquaintance with the specialities of other branches of the service. But I happen to be a very zealous though perhaps a very humble student of our *past* military history, and while the lecturer was speaking, several facts of our past history struck me as bearing upon

the points under discussion. I do not propose to take up much of your time, but I will, if you will allow me, recall to your minds one or two facts of our military history, and will confine myself more particularly to the subject of dragoons. I need scarcely repeat to this meeting that our modern dragoon is not a dragoon at all, just as our modern hussar has lost all the original characteristics of a hussar. The dragoon that I now propose to speak of, is not a cavalry soldier for infantry duty, but rather an infantry soldier who may occasionally do cavalry duty. The old dragoon was a mounted soldier so trained and equipped as to act as flying infantry. Occasionally he was required to act as cavalry also, but his more proper duty was that of flying infantry. In the very first battle in which the dragoons of our present standing army took part—the battle of the Boyne—there was a very striking instance of the utility of this combination of cavalry and infantry. During the pursuit of the Irish army, General De Ginckell, at the head of some Dutch dragoons, the 3rd Dragoons, and part of the Inniskilling dragoons, came upon a large body of the Irish cavalry who always behaved uncommonly well in that war. They behaved on this occasion with such valour that De Ginckell, with his Dutch dragoons, who were foremost, were driven back, pell-mell down a narrow lane. The Officers commanding the other two regiments, the 3rd and the Inniskillings, seeing what had taken place, drew off into the fields and dismounted their dragoons. They lined the hedges and also occupied a house which overlooked the lane. The result was that the Irish cavalry were so puzzled by being met unexpectedly far from the main body of the English army, by the sudden fire of infantry, that their temporary victory, which might have done great damage, was turned into a rout. In this instance we not only see dragoons acting as infantry in support of cavalry far in advance of the main body, but we see them able afterwards to re-assume the character of cavalry, and re-join in the pursuit. I merely recall these facts to your minds that you may turn them over and see from our past history whether you may not learn something with regard to these points. In 1693, at the battle of Neerwinden, another instance of a quite a different character occurred. It is impossible to say that the victory of the French over the British, and their allies would not have been a victory ultimately, because of very serious flaw in the position occupied, which nobody can fail to see. But at the same time there is very little doubt the French would not have pierced the position where they did, had not the dragoons (of which our English dragoons formed a portion) been retained on the left wing to act as cavalry instead of being detached to the right in the support of the infantry, who were being there overwhelmed, in place of the infantry who were so detached. I will mention but one more instance. In the very next campaign there was another instance quite of a different character again. And let nobody think that we can learn nothing from these facts of past history, for facts are after all the clinching nails of theories, or the coffin nails of theories, and the very circumstances that called dragoons and hussars into existence were the circumstances which now seem, from all I can learn, to call for some change in our cavalry—namely, the greatly increased power of artillery and fire-arms. In 1694 there was a race between the British with their allies, and the French, from the Meuse to the Scheldt. It was of great importance to the French that the allies should be forestalled at the Scheldt, for the French position there consisted of entrenched lines, and if the French lines were forced, the campaign was lost to them. It would be too tedious to recount all the circumstances, but readers of our past history will remember how that was. That fact was palpable. Therefore, the French Commander, with great foresight, anticipating that such a step might be taken by the allies, although he was powerless to prevent it, sent on in anticipation to an intermediate post, about 3,000 dragoons. When the race began the allies had about 80 miles to traverse, while the French had 120 miles to traverse, and by a route which was so cut up with bad roads, so thick with forests, so intersected by rivers, that on the 4th day of the march, the French infantry gave in altogether, and it became necessary to call for volunteers to go on. Although they were allowed to cast away their knapsacks (which in those days were very seldom carried by the troops themselves); and although they were supplied with spirits along the march, yet all would have been utterly in vain, were it not for the main body of dragoons. The main body of French dragoons were sent on with all rapidity, and they marched with such energy that they not only

came close behind the 3,000 men who had been sent on in anticipation, but the English having rather presumed upon having the shorter distance to traverse and so not having put on full speed, they arrived just in time to prevent the attack. In this instance there is no doubt, no troops but dragoons could have performed this duty, no troops but dragoons could have saved de Luxembourg from the result of an attack on the entrenchments. I might have said in regard to the previous instance that I have mentioned, that the battle was one of those in which the student can see that it might have been a battle of infantry or a battle of cavalry, as circumstances might turn out, and in which nobody would be able to prophesy how these circumstances might turn out. It was, therefore, one of those battles in which the utility of dragoons seems to me to be greatly exemplified. I might mention also that in the Irish war to which I first referred, some four men of every company of the 2nd Queen's Foot were formed into a troop of dragoons and did very good service. They were solely infantry men, and were mounted, and they were found of the greatest use. It is possible, perhaps, that somebody might improve upon this idea, and that some such system might be adopted without abstracting from the strength of our infantry, while yet obtaining some sort of real dragoon. I should just like to mention what the original hussar was. It is quite worth while thinking when we hear so much about scouts and reconnoitring parties of cavalry, whether the hussar might not revert to his original *rôle* of a scout. The hussar originally—not in our armies for we had none at all, we were then, as now, incapable of originating a military idea—but in the French service where they were first adopted, was a soldier distinguished for individual intelligence and especially individual horsemanship and swordman-ship. These men were employed particularly in scouting and reconnoitring duties. It is possible then we may return with advantage to the original *rôles* of cavalry by having the hussar for individual irregular duties, if I may so term them, and the dragoon for the duties of flying infantry, and the cuirassier for the duties of the charge in which last, nevertheless, all the others might join. For they might be trained so as to perform their particular duties, and on occasion only, to join in the general duty of cavalry. With regard to the cuirass, an idea has often struck me, and I dare say it has struck others. It is this: I do not see why the cuirass should be made as flat as it is. I would suggest that it should be made having a series of angles, rather acute angles, something like a bees' cell cut in half, because in that case a bullet striking it must go off at a tangent. It is very seldom that the bullet would strike the very small face which would offer itself on the different sides.* That is an idea which has struck me, and I throw it out for consideration.

Lieutenant-General Lord George Paget: Not having been present when Colonel Baker spoke last Wednesday, I know not whether he dwelt on the one point to which I would now refer, but I know that he and every cavalry Officer will cordially agree in the remark I am about to make. It is this: without entering on the question of how far the establishment of these mounted riflemen, of whom we now hear so much, may be of advantage—and I, for one, believe that they might be of much use in modern warfare—I would urge the impossibility of their establishment as part of a cavalry regiment, as it is at present constituted, and unless there is a greater proportion of men to horses. Everyone knows that at soldiers' games, for instance, of an afternoon at Aldershot or elsewhere, while crowds of infantry soldiers are enjoying themselves, hardly a cavalry man is to be seen. He is hard at work cleaning his appointments, &c., and has no time for anything else, and he cannot have added to his duties, the instruction in the use of arms of precision. Besides, for many reasons, I do not think that mounted riflemen, who are to use arms of precision, should have to groom horses. Therefore, I say, before the contemplation of such an addition to the calls on the time of the cavalry soldier, it should be determined as an established

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* Another idea, that I omitted to mention until after the discussion, is that cuirasses might be made of *cuir bouilli* instead of metal: if made in a series of angles they would, I expect, be found equally effective for defence, while they would be lighter to carry, far more cleanly on active service, and an economy of the soldier's time in garrison.—C.W.

fact, that there should be a greater proportion of men to horses than there is at present.

General Sir William Codrington: I dare say some Officer here can tell us what is the system of the Prussian cavalry in this respect, namely, as to whether their regiments have as many horses as men. I think the number is 500; but it is so totally different a system to that which is advocated by cavalry Officers here, that if there is any Officer who knows the habits of the Prussian cavalry, it would be an advantage to have information on the subject. I think I am right in saying that the Prussian cavalry have no spare men in their regiments, that every man is mounted. (Colonel Baker: Nominally, it is nearly so.)

The Chairman: Gentlemen, I beg to say a few words with regard to Colonel Baker's excellent lecture. And in the first place I should wish to make a few remarks about mounted riflemen.

There is no doubt that mounted riflemen have become absolutely necessary for the service; but I would make them a separate corps altogether, being neither cavalry nor infantry. To form this corps I would pick out men from cavalry or infantry regiments—the best men that could be obtained from their intelligence and activity—they should be made available for any purpose, and when used as infantry, the centre man should hold the two outer horses.

In Colonel Baker's lecture, on the subject of horses, he states,—"to effect this, it is suggested that, in place of the present tax upon horses, an *ad valorem* duty should be imposed; that all horses classified by their owners at a certain value, which would be within the limits of reasonable expenditure for military purposes, should be inspected, and that such as were eligible, should be registered. That horses so registered should, by Act of Parliament, be liable to be purchased by the Government at their classed value in case of probable war or invasion; that in consideration for such liability, these horses should be exempted from taxation whilst remaining so registered."

This project of Colonel Baker's I am inclined to conceive would be very difficult to carry out in this country. The so-called liberty of the subject would be interfered with; and I cannot conceive any Act of Parliament would ever be passed to compel a man to retain his horse for Government purposes at a comparatively small price, when a purchaser might come forward and offer a higher sum. At present, I understand from the returns, there are no less than 300,000 more horses in the country than there were ten years ago, and I can only say that at Aldershot the remount-horses of the 13th Hussars and of the Carabineers are the best lot I have ever seen. They have good legs, good shoulders, and fair action, and the Commanding Officers tell me there is no difficulty in obtaining them. Of course everything is increasing in value, and Government will be obliged to pay more for their horses; but they are to be obtained, and without any difficulty.

I quite agree with Colonel Baker in considering a "cavalry reserve" as most essential. It should, I consider, be carried out according to the Prussian system, viz., on service to have three or four squadrons for the field, with one squadron at home to supply deficiencies. It is the only way in which cavalry can be well kept up. And if a good reserve is not formed it will be just as it was in the Crimea, when, as mentioned by Colonel Baker, at a review, only one squadron was able to turn out, formed from the whole cavalry force.

There is another point at page 381, where Colonel Baker says,—"Officers commanding cavalry regiments, and the Officers buying for the Royal Artillery, would be allowed each year to purchase an additional per centage of horses. These horses would be trained with their respective corps for one year, and the additional per centage so purchased, would then be handed over to the Yeomanry upon the following conditions:—They would keep these horses at their own cost; would ride them when under arms with their regiment; would maintain them in good condition, as certified by periodical and reported inspections by the Yeomanry Adjutants. They would give them up, if required, for five weeks after harvest."

I can hardly imagine that this proposal could ever be carried out with advantage to the service. For instance, the cavalry and artillery would not be inclined to give up good horses that they had trained and had in their possession for a year; and I should also think that these horses kept by small farmers—for I suppose they

could not be considered rich or wealthy men—would be kept in good condition. They would be used for all sorts of work—in ploughing and drawing heavy carts—and many of them would become useless for the service.

Then Colonel Baker states that lancer regiments should have nothing but a lance and carbine. The late Earl of Rosslyn, my Commanding Officer in former days, was most anxious to arm the 9th Lancers with the carbine. He tried it, fitted in nearly the same way as it is carried at present, behind the leg, and in the old way in which it was before, but he found it so interfered with the lance as to be quite impracticable. It would, however, be most advantageous to the lancer to carry the carbine, and I would put it across his back. Any gentleman who has been in India and has seen the way the irregular cavalry carry them over their backs, must know the advantage of this. They take off the carbine at the full gallop, fire it, and return it without stopping. It does not wear-out the clothes, and it does not wear out the man.

I also do not concur with Colonel Baker in the suggestion to do away with the pistol, especially with the lancer, unless he has a carbine. Every man without the latter should have a revolver attached to his person. The Prussians carry the common pistol in a small holster, attached to his body by a strap over the shoulder.

With regard to his proposed system of flag-signals, at present at Aldershot it is in such an unsatisfactory and imperfect state that it is of little use. A new system is about to be established by which information will be more correctly afforded.

There is one point in which I quite agree with Colonel Baker, and that is with regard to the scouts. I think his system is a very admirable and good one.

Captain Trench, in what he stated, threw cold water upon the continental system as carried out in our country. Now, it appears to me rather out of place to state this, as we must feel the Continent has had a great deal more experience in warfare than we have had, and it is necessary to take the best examples in everything. We have to improve our system, and it is to our advantage that we have copied the Continent in many things relating to war.

There is one point which I forgot to mention, viz., about the kit of the men. I am of opinion that the cloak should be carried in rear of the saddle, and that the man should only have—besides what he has on him—a complete suit of blue flannel, viz., a pair of trowsers, a jacket, and a shirt. The trowsers should be carried under his seat, in the way the Prussians do, only that their trowsers are made of canvas. On service a man should not shave, or polish his boots. A little oil or grease would be sufficient to rub over them He should also have a pair of highlows. This is nearly all a man should carry on service.

Major Webber, R.E.: Colonel Baker has referred to the use of cavalry mainly for purposes of intelligence, as having become more and more important, owing to the greater necessity for that intelligence being early.

The collecting of intelligence as one of the most important duties of cavalry, has always been recognised in the history of war, and we find the Duke of Wellington in the Peninsula only using his German cavalry for that purpose, in preference to his English, because the Germans were men who took more quickly to, and were more to be depended upon, for work of that kind. As we cannot always depend on mercenaries, and as the covering the front of an army with intelligent men at a very early period of a campaign is so necessary, it is obvious that the training which Colonel Baker describes as having been so easily imparted to the non-commissioned officers and privates of his own regiment should be universally given. And with reference to this, I cannot understand Colonel Baker's statement, that no cavalry quarters except Aldershot and the Curragh, has been found by him to afford any fair opportunity for proper instruction during thirteen years' experience.

I should like to ask Colonel Baker what impediment exists at Shorncliffe, Norwich, and other stations, or even in the neighbourhood of London, to using the surrounding commons and roads for instruction in outpost duties. It is true that the inclosures may not be ridden through; but it seems to me that as we find no difficulty in teaching cadets and Officers to reconnoitre on enclosed commons without trespassing, a large proportion of the duties of cavalry in patrolling and outposts, can also be taught, even if the men never left the beaten tracks.

I am very glad that Colonel Baker has recognised that outposts and their videttes

or patrols, have a different duty to perform to scouts. Perhaps it will be allowed that these duties may be classified as passive and active. The one reports what he observes from a fixed point, or from a moving point, which maintains a constant relative distance between it and its support; the other *searches* for intelligence, using his own judgment to guide him in all he does.

It is not too much to say that this distinction holds good in every operation of war. Whether an army is advancing, retreating, or stationary—whether it is covered by cavalry or infantry posts, there must always exist a fringe of *look-outs*, placed according to the accidents of the ground and (definitely) with reference to the covering force. But it not the duty of these *look-outs* to wander in search of intelligence, and it is this constant difference that distinguishes the "look-out" from the *scout*. That this scout, who is a most important means of collecting intelligence, should be exclusively part of the cavalry organisation of an army I cannot agree with Colonel Baker in thinking. Take, for instance, the advance of the Prussian 3rd Army and the Army of the Meuse on Paris after Sedan. This advance was covered by two divisions of cavalry, but when the front came near Paris, the cavalry turned to right and left, and passed round to the west, the infantry corps coming to the front. I would ask Colonel Baker if he considers that in such a case all the intelligence on the east of Paris should have still been collected by cavalry, and transmitted through the cavalry head-quarters before reaching the Chief of the Staff?

This is only one of innumerable instances that could be given to show, that although cavalry is the best, and, we might say, the only arm suitable for screening the operations of an army, it does not also follow that its utility as a means of collecting intelligence, goes beyond the observations of what comes within its range in performing that most important duty.

I feel pressed to say a few words, which necessarily follow on Colonel Baker's remarks about "signalling;" the Signal-corps of the Southern Army at the last Autumn Manœuvres, consisting of 16 Officers and 76 non-commissioned officers and privates, having probably been worked on a larger scale than has been before attempted, I think it is right to explain the arrangements then made, as Colonel Baker will be glad to hear that their tendency was to meet the view which he takes, namely, that the signallers should be attached to brigades. Every Army-Corps-order that was issued on the subject, tended to make the brigade the unit for signalling purposes; and the simple reason why the signallers were not left always to work with their brigades was that half of the Officers and men had to be taught the rudiments, and the rest knew little of the application. Thus, like all branches of the service, the signallers were under instruction, and if they had been left entirely to their brigades, I venture to say, that in many cases they would have learnt nothing. As it was, on each occasion, when not required to open or maintain communication for head-quarter purposes, the signallers remained with their brigades, and with that view the following orders were issued:—"Should a detachment from one or several brigades march "on duty, a signal-party will, as a rule, accompany it; the Senior Signal-Officer "present, to make the necessary arrangements. If a brigade is in reserve, one of its "parties will be ordered to report itself for service at the divisional head-quarter "station. As a rule when the army is not in action, the brigade-signallers will be "employed sending information from the front to head-quarters. When in action, "the Signal-Officer's chief duty will be to keep up communication between the Brigadier and the divisional head-quarter station. Lateral communication need not "be established unless specially ordered. Brigadiers will be requested to advise "the senior Signal-Officer of their brigade, of any proposed movement or detachment "as early as possible. The senior Signal-Officer to report himself daily to the Brigade-Major of his brigade; the hour being specified in brigade orders. If, during "the day, the brigade is about to make any other move, the Signal-Officer will also "report himself before the brigade moves off, in order to make himself acquainted "with its general objects." Colonel Baker himself suffered, I am sorry to say, for the great efficiency of the signallers in his own regiment, by being thus at times deprived of the services of a larger number of men than other Commanding Officers; but if the operations had continued longer, he would have found that, as the Brigadiers grew more to use the signallers, and the men became more expert, they would have been less detached for special purposes, when the head-quarters would have depended only on the engineer signallers.

When the cavalry of the Southern Army advanced to the great ridge above the Wiley, the Officer at head-quarters who was in charge of the signalling was attached to the General commanding the cavalry, and all the arrangements of that day were made under his instructions, and between twenty and thirty messages were forwarded to the head-quarters of that Officer during the day from a look-out post in the front. If from the independent action of the signal parties and of the *scouts* and *look-outs*, the consequent confusion of intelligence arose which Colonel Baker describes, it seems to me that it is only confirmatory of his remark, that signalling, as a means of communicating intelligence is not understood, and therefore not encouraged. By encouragement, I mean recognition. A signal Officer, who is fully as intelligent as a scout, when he has established a signal station to which the scouts should carry their intelligence, is not a little surprised, and perhaps disheartened, to find that a horseman is galloping off with intelligence that he knows he can send without wear and tear to horses' legs, and to be told by the scout that he knows nothing about him, and that his, the scout's, intelligence is destined for some point where he believes the Officer commanding the cavalry to be at that moment, perhaps miles away from the point where the signal Officer believes him to be.

If manœuvres were actual war, no doubt signalling would find its place, and the General who knows best how to use it, will obtain a corresponding advantage; but as manœuvres are a means of instruction, a cavalry Brigadier and his Brigade Major are naturally thinking of other things which, at the moment, are of more vital importance, and therefore signalling, which essentially requires a knowledge of its powers by those who employ it, receives little attention, and is in proportion not dependable.

Captain Hoseason, R.N.: In the very interesting paper read by Colonel Baker, he has named the total proportion of animals to men. This is the first time we have had these facts so accurately stated, and we find the proportion, in round numbers, to be as 1 to 3, or 13,000 animals to 37,000 combatants. In many previous discussions in this Institution, a far greater number of animals was supposed to be necessary. It has even been stated that the numbers ought to be equal; or, supposing a force of 100,000 men invaded this country, 100,000 animals would be required to be brought over; but Colonel Baker states that the Germans have found in their late great wars the smaller number sufficient, when supplemented by auxiliary transport obtained by requisitions.

In addition to the service performed by cavalry in outpost and scouting duties, there are those of foraging and requisitioning, two very arduous and important duties, which will always make the services of cavalry of great value, as the supplies thus gathered may be drawn from a large area of country instead of from fixed bases of operation; this was sufficiently proved by the activity and ubiquity of the German cavalry in the late war with France.

In the discussion on Mr. Vernon Harcourt's paper, much misconception as to the facility of transporting cavalry by sea, arose from facts not being clearly stated, and the present value of steam transport fleets not being better known. Mr. Harcourt appears to have been unaware that two steamers of only 2,500 tons burthen, belonging to the General Screw Company, in the service of Government during the Crimean war, conveyed respectively 640 and 560 horses each, and that the voyage from Varna to Eupatoria, a distance of about 300 nautical miles, was performed in about a day and a half. The horses were nearly all placed in the vessels' holds, and they were embarked with all their accoutrements on them complete, and not a single article of those stores was missing when the force was landed at Eupatoria. The whole force moved was 50,000 men, with a great amount of animals and stores, and the operation was conducted under the auspices of Captain, now Rear-Admiral, Eardly Wilmot, R.N.

I need hardly point out how simple must be the task of moving any amount of animals in the present day, with the improved means of steam-transport we have at our disposal, in vessels varying from 500 to 5,000 tons burthen, and driven at velocities varying from twelve to sixteen knots per hour. A few hours alone will suffice for the transit, if the ports to be reached, are Calais, Boulogne, Ostend, Flushing, or Antwerp, for the maximum distance of over-sea transport from Dover to Flushing is eighty-seven miles.

Colonel Baker: I will now notice very briefly in reply, the different remarks that

have been made by those gentlemen who have joined in the discussion to-day. Colonel Goodenough has been kind enough to give us some information relative to the Austrian system of reserve horses. Yet from what he has told us to-day, I should myself prefer the Prussian system. The Prussian system prepares for war beforehand. The horses required are known and registered, and they have nothing to do but to collect them on the outbreak of war. It appears by the Austrian system that although the horses are known, they have to be selected and purchased after the outbreak of war.

Colonel Goodenough has spoken about repeating rifles, and he urged that repeating rifles might be given to cavalry. Now the Henry-Martini rifle, which will be shortly issued to the cavalry, is really such a very good weapon, and can be loaded so rapidly, that I think its simplicity more than counterbalances any advantages that would be derived from the use of the repeating rifle.

Colonel Goodenough has also mentioned that a system exists in the Austrian Army by which men are specially trained as scouts. It appears that very few men are so trained. The plan, no doubt, is valuable, but it seems to me that if the system of garrison instructors which has now been established in different camps and in large military stations were increased, so that we had regimental instructors, we should have a means of instruction for both men and Officers, which would be most valuable. I mentioned the other day that I had endeavoured in the 10th Hussars to carry out that system, but it was done under considerable difficulties. It is quite evident if we had regimental instructors attached to our regiments, their duty would be to instruct Officers, and also to instruct the men in the special class-duties—if I may so call them—which should be known preparatory to trying scouting duties upon a practical scale in the field.

I will now allude to the remarks which were made by Captain Trench. I think he made one mistake when he said that the Austrian and Prussian cavalry carried more weight than our own. That was the case, but certainly now on service neither the Austrian nor the Prussian cavalry would carry the same weight which is laid down for English cavalry.

Referring to the remarks made relative to the old history of dragoons, the gentleman who made the remarks seemed, I think, to be unaware that dismounted duties are more or less practised by the cavalry of the British Army at the present moment. I am sure certain Commanding Officers—and I myself have always laid great stress upon it—have paid great attention to the instruction of their men in dismounted duties, but I think that we hold generally that there is a limit to this instruction, and that if we attempted to train our men really as infantry when dismounted, we should deprive them very much of their value as cavalry. In the first place it must be evident to everybody, that a cavalry soldier dismounted, cannot be on a footing with an infantry soldier. His arm is a shorter one: it has not the same range. Again, he carries no bayonet, and if it comes to close quarters he is at a manifest disadvantage. All this should be taken into consideration. My own view is that we shall make a great mistake if we attempt to revert to what I may call the bastard dragoon—a system which has been tried from time immemorial, but which has always failed, because the dragoon, if attempted to be made an infantry soldier, invariably becomes more of a cavalry soldier, and only a bad one. What I think we should find most useful, would be to have a small force of infantry mounted and attached to the cavalry, composed of highly trained special troops. I myself would not even give them a sword, and so would prevent the possibility of their ever becoming cavalry. I would keep them as special highly trained infantry, to be used on emergencies or particular duties.

I will now refer to what was said by Lord George Paget, and I am sure he will carry the whole cavalry service with him with regard to having plenty of extra men for the horses. We all know, if you get a large proportion of men to horses in cavalry regiments, you have a number of trained men in case of emergency, and that the horses, when they are purchased or provided (as I trust we shall have them provided in course of time), are much more rapidly trained than the men. The horse can be trained in the course of a few weeks, whereas a man cannot be trained in anything like that period, or under one year.

Sir Wm. Codrington asked a question relative to the cavalry of the Prussian

Army, and referred also to the number of dismounted men, or rather the apparent absence of dismounted men in the Prussian service. I think that this is more apparent than real. I stated the other day that in continental armies generally, such arrangements are made that the dismounted men of cavalry are not drawn upon to the same extent when war commences, as in the cavalry of the British Army. For instance, as I mentioned the other day, we all know when we go into the field, regiments are immediately applied to for dismounted orderlies and staffs of brigades and also of divisions. That does not exist in the Prussian service, but the staffs are made up beforehand, and the Prussian *etappen* also really assist in a great many duties which at present fall upon our cavalry very heavily.

Referring to what was said by Major Webber, I am sure he very much misunderstood me if he thinks that I underrate the value of flag-signalling. I think flag-signalling, if properly used, may be very useful, especially in outpost duties. I do not think we ever can trust implicitly to it. We all know that even a change in the weather, a foggy day, or a misty morning, renders flag-signalling useless, and therefore it would be very foolish, to my mind, to trust too much to it. But on the other hand, if we had a system thoroughly understood, if we aimed at what was possible and did not attempt too much, it certainly might be most useful. And I think the reason that flag-signalling has not made more way than it has, has arisen from there being no definite place for it. I think if we could look upon it as an adjunct to be used especially in outpost duties, it might be very useful, and I for one should be most glad to see it brought into more general use in the service.

Major Webber asked me whether I had not stated that there was great difficulty under most circumstances in giving troops proper instructions in outpost duty, and he mentioned the cases of Shorncliffe and Norwich. Now, I have had detachments at Shorncliffe and been stationed at Norwich, and I must say in neither of those stations do I conceive that outpost duties can be practised properly on a large scale. Those who know Norwich and Norfolk, know that it is a very enclosed country. It is true that there are a few small heaths which may be sufficiently large to give recruits a sort of commencement of instruction, but I do not consider that in that county,—unless we have power to go over land, really to trespass, and unless those powers are given to us by Act of Parliament—it is possible to carry on outpost duties for cavalry upon the scale which I conceive should always be practised.

He has also remarked upon what the Prussians did at Paris, and he asks me whether I conceive that the duties of getting information should be exclusively confined to cavalry. Of course where infantry are placed in such a position that they are enabled to obtain information—and the siege of Paris was principally an operation of infantry and not of cavalry—then such information should be given by infantry as well as by cavalry.

Captain Hoseason has touched upon the question of scouts, and of foraging and requisition duties. I dare say Captain Hoseason is aware that the Prussians have no special corps for requisitioning, but it is a duty which falls occasionally upon cavalry or any body of troops acting in a hostile country and naturally having to make use of that right, and being accustomed to it, the Prussians shewed quick aptitude for it. Captain Hoseason has also touched upon the question of the decrease of cavalry being possible.

Captain Hoseason: No. I said one of the heavy duties put on the cavalry is that of foraging and requisitioning, and with that I said I imagined that the inability to transport any amount of cavalry would prevent the sending of a large force.

Colonel Baker: I understood you to say that cavalry might possibly be decreased and against that I was going to urge that the Prussians considered it necessary to make an increase.

With regard to the cavalry transport, I most cordially agree with Captain Hoseason. I do not think we have taken into consideration the immense facility which these very large steamers will give in the transport of horses. It is a question which really merits the greatest possible attention, and instead of leaving it to be provided for when war arises, and everything is naturally in confusion, I think that it is one which ought to be thoroughly gone into at the present moment.

I think I have now touched upon all the points which have been noticed, with the exception of the remarks of our Chairman. The points I shall notice in his remarks are those relating to reserve of horses. Sir Hope Grant has stated that he thinks that the system which I proposed, namely that there should be a reserve of trained horses kept up with the Yeomanry, and a reserve of transport horses kept up by a system of previous registration, would not work in this country. With regard to the first question, namely that of trained horses, I cannot see why we should not make use of the Yeomanry for that purpose, especially when we find from Colonel Goodenough to-day that this very system—and I was not aware of it before—has been tried by the *honvéd* cavalry and has been found to answer very satisfactorily. I think this is a great proof that we might attempt some similar system in England with regard to our Yeomanry.

Sir Hope Grant also touched upon the question of the registration of horses. What I proposed was that there should be an *ad valorem* duty in place of the present tax upon horses, and I will just explain my meaning rather more at length than I was able to do in my lecture the other day. I dare say you are all aware that agricultural horses are at present exempt from taxation, but there are upwards of 800,000 horses now paying taxes in this country. That tax is at present 10*s*. 6*d*. per horse. What I should propose would be that, assuming an amount which would be recoverable to be given in case of war for horses for military purposes,—if we say £60 or £70—that horses classified by their owners as of that, or below that value, should pay the present tax of 10*s*. 6*d*.; that horses classified between that and £100, should pay, say 15*s*., and that horses valued at over £100 should pay a further increased tax, or, we will say £1. The working of this plan would be as follows:—If anybody wished to exempt his horse from registration and from possible requisition, he would naturally rate him, we will say at £100, or 15*s*. tax. He would pay a small increased tax, and his horse would not be liable to requisition in case of war. Therefore, it would be only those who with their eyes open registered them below £60 or £70, as the case might be—whichever sum might be determined upon—who would have their horses liable to requisition. I must say I cannot see any very great hardship in this, especially if you absolve those horses from taxation. I do think we are all in this country too much inclined to lay unnecessary stress upon the "liberty of the subject." Whenever any great scheme of military organization is brought forward, we immediately hear of the "liberty of the subject." But I remember—and it was only four years ago, in 1869—urging the necessity for Autumn Manœuvres. I was then met on all sides by the question of, "Do you consider it possible in a country like this, where people have their rights, and where they are so tenacious of their rights, to have 'autumn manœvures,' and to manœuvre over other people's ground, whether they like it or not?" They said to me, "Do you think for one moment people would allow autumn manœuvres in September, when they would have their partridge-preserves gone over by troops and disturbed in this sort of way? It would be impossible, and any Ministry who dared to bring such a thing forward would not be in office for a day." What did we see? After a little time the Ministry did bring it forward. There was not even a division in the House upon it. The Act was passed; we have for two years had "autumn manœuvres," and we find people from all parts of the country are scrambling to get the troops to manœuvre in their districts. I must say, an Englishman, although he may be very tenacious of his rights, has some regard for his duties, and I do think that if the question of the reserve of horses—for we must all allow that a reserve of horses is imperative, and that without it our military efficiency is *nil*—I think that if that question were placed before the people of this country in a straightforward common-sense way, they would make their duties rise superior to their rights.

The CHAIRMAN: I think that the lecture has now been fully discussed, but before we go, we are bound to return our best thanks to Colonel Baker.

IS A RADICAL CHANGE IN THE TACTICAL FORMATION OF OUR INFANTRY REALLY NECESSARY?

A Lecture delivered at the Soldiers' Institute, Fort William, Calcutta, by Lieut.-Col. and Brevet-Col. The Hon. FREDERIC THESIGER, C.B., A.D.C. to the Queen, Local Major-General, and Adjutant-General in India.

MUCH has been written since the late war between Germany and France regarding the changes which it will be necessary to make in the tactical formation of our infantry attack, so as to make it applicable to the altered conditions of modern warfare; and it seems but too evident that the deductions which modern writers on the future tactics of the British Army too often draw from the experience of the late war are, that our two-deep line formation, so long regarded as a thoroughly British institution, must be looked upon henceforth as impracticable, and that the German skirmisher-swarm formation must take its place.

Now if there be any value in the words of the author of "A Tactical Retrospect," that "to change that which has become customary and deeply rooted in an Army is always a critical matter, *but to make wholesale alteration is ruinous*," it would seem wise, before finally accepting a conclusion, which brings a revolution in its train, to pause and carefully consider the grounds on which it is based.

The following extract from one of the essays written for the Wellington prize, shows clearly the line of argument adopted to prove that the line formation is unsuited to the tactical requirements of the day:—

"The aim of a tactical system should not merely be to produce flexi-
" bility, the power of conforming to the exigencies of the situation, and
" the irregularity of the terrain, but elasticity, the power of regaining
" the original shape, the primary formation.

" The line formation, as the chief feature of our drill, provides us
" with neither of the above requirements to any extent, but simply
" gives a rigidity that occasions both slow movements, and consequent
" longer exposure to fire, and also the utter impossibility of utilising
" cover, or suiting the dispositions to the ground.

" The range of fire has so much increased, that everything must give
" way to rapidity of advance; and while the battalion column is too
" large, too marked an object to attempt the forward movement without
" risk of annihilation, the line is so slow as to suffer almost equal loss.
" The deployed battalion of infantry is just as deadly an order, if long
" under fire, as the more compact columns, moving from cover to cover
" with quickness, and presenting but a small front to the adversary's
" projectiles."

Now there are no less than sixteen sections of the Field Exercise Book which describe the different methods by which a line can be made to conform to the exigencies of the situation, and the irregularity of the terrain, and afterwards to regain its original shape, its primary formation. They will be found under the headings :—

Formation and movements of a battalion in line.

Formation of column from line.

Formation of line from column.

Deployments.

Movements and changes of front in échelon.

A battalion in line can be sub-divided without confusion into as many parts as there are companies; and as these companies are now not required to preserve any special numerical order, it follows that the line can be broken up and reformed with the greatest facility and without the slightest confusion.

The necessity for great flexibility and elasticity in an attack formation having only lately been fully recognised, no real attempt has as yet been made to bring out the full powers of the line; and the formation has been condemned, not because it does not possess these essential qualities, but because, having been allowed to lie dormant, they have been overlooked or misappreciated.

"The days no doubt are past," as says another writer of one of the Wellington prize essays, "when successively deployed stiff lines of infantry could advance as we did at the Alma;" but if troops in line are only handled so as to meet the requirements of the day, and so as to avoid unnecessary exposure to fire, the formation will, I believe, assert its superiority over any other in the same manner as it has always hitherto done.

The most serious charge of all which have been brought against the line is slowness.

I am not prepared to admit, however, that the line, even under its present conditions, is necessarily slow; and I am sure that any well drilled battalion without any previous practice, will be capable of advancing or retiring in that formation, in double time, for a considerable distance, without any material disarrangement taking place.

But if the advance be made by échelon of half battalions or of companies, the most rapid pace becomes perfectly feasible.

It is possible that it may be found advantageous to allow more freedom to troops advancing in line, by giving each man in the ranks 30 inches instead of 24, or by giving each company a small interval between those on its right and left: these are minor points which can easily be worked out on the drill-ground.

The real question for consideration is, can troops in two-deep line formation be brought over a distance of, say 2,000 yards, under the fire of modern artillery and breach-loaders, with as little loss as would be incurred by an equal number of troops moving over the same distance in the skirmisher-swarm formation?

2,000 yards appears to be the distance which most writers admit will fairly represent the space to be traversed by an attacking force under the effective fire of an enemy holding a strong position. But for

the first 1,200 yards, in all probability artillery fire will alone have to be considered, as modern practice seems to condemn the system of pushing skirmishers forward in front of a defensive position. You will find at page 428 of the latest edition of "Hamley's Operations of War," the following passage:—

"The first question is, whether the line of skirmishers which has "hitherto generally opposed the assailant's skirmishers in front of the "position, is still appropriate. Before a sustained attack in force, these "skirmishers must, as a matter of course, be withdrawn. But to retire "in face of breech-loading arms, and in presence of such a force as the "skirmishing line of the assailant now comprises, would be a costly pro- "cess; and the defender's skirmishers would certainly suffer far more "loss than they would inflict, while a brisk advance might bring the "enemy almost to the position at their heels; when the fire of the "main defensive line must, in some considerable degree, be masked by "its own skirmishers."

"The first line must then be that which first opposes the enemy, "and it must be carefully sheltered in order to derive due advantage "from the defensive."

This view is in accordance with the experience gained in the late war. Boguslawski says, "Occupy in force the actual line of defence "with strong bodies of skirmishers, advanced posts should only be "occupied when they are particularly tenable."

At 2,000 yards a 9-pounder rifled gun, firing shell, has an error *longitudinally* of about 80 yards, and *laterally* of about eight yards. Therefore when a battery fires with a clear view of the object at 2,000 yards, the range being known precisely, and no mistake being made in the service of the guns, it is to be expected that a shot will be sometimes 40 yards short, and sometimes 40 yards beyond, or sometimes four yards to the right, or sometimes four yards to the left of the target.

The longitudinal error being therefore so much greater than the lateral error, it follows that the deeper the formation, the more chance it has of being hit; but the lateral error being so exceedingly small, a greater or less *breadth* of formation really makes no appreciable difference in the value of the target.

Viewed simply then as an object to fire at, it may be said that the two-deep line is the target which artillery would least like to have opposite to it. Of course if troops in such a formation are kept moving, the difficulty of hitting them increases enormously.

Under artillery fire alone, therefore it seems certain that troops which are kept in the formation nearest approaching a line will suffer the least loss; and consequently by dividing a regiment advancing to the attack into three lines of skirmishers, supports, and reserves, the chances of casualties would seem to be actually increased.

From 800 yards up to striking point, the effectiveness of modern infantry fire has increased enormously, whereas the effectiveness of artillery at these close distances has not improved. Case fire from rifled guns ranges to a rather less distance than that from the old smooth-bore guns, and at very close distances it is about as effective.

A well-aimed infantry fire is therefore more effective than the case fire of artillery, and consequently the latter cannot remain within case distance of unbroken infantry unless the battery is intended to court almost certain destruction.

Such being the opinion of one of the *great artillery authorities of the day, *it is clearly permissible to eliminate from my calculation the effect which artillery fire is likely to produce on infantry advancing to the attack from* 800 *yards.* That effect is shown to be no greater than formerly, and therefore the attacking force will not be called upon to sustain any more increased strain on its enduring powers than it would have had formerly under the fire of smooth-bore artillery.

In the advance then from 800 yards the effect of infantry fire alone will be considered.

" In the field, one has to deal with fire more or less well aimed, and " more or less blindly delivered. It is customary to consider the first " description of fire only as effective, and to look upon the last as thrown " away. Both descriptions, however, fill up a certain space of ground " with projectiles."

" In peace we very properly set value only upon aimed fire, and in " war we very properly desire our soldiers to aim; but a leader should " be aware notwithstanding, that the enemy's unaimed or badly aimed " fire has a great importance. The shot which misses its mark can pro- " duce effect near it. If it passes over the mark it makes the ground " beyond unsafe. Shot do not only produce effect on the mark aimed " at, but create an unsafe region along the whole line of their course; " and unaimed shot kill and wound as well as aimed."

" In any case this fact deserves the greatest consideration, viz., that " under small-arm fire we have never to deal with more than 25 per " cent. of shot which are aimed."

The same authority† lays down that firing is as a rule too high. It therefore follows that if only 25 per cent. of the shot are aimed (that is to say are on or about the mark) then *nearly* 75 *per cent. go over the mark*, and depth of formation must entail a loss which will go far to neutralize the advantage which an extended order must of course give to the attackers when under the fire of breach-loading rifles.

But from the instructions laid down, it is clear that when the enemy's fire becomes really heavy it is intended that the front line of the skirmisher-swarm formation should be reinforced until it contains every man in the battalion—for they say:

" The attack to commence by a general advance. If required the " skirmishers would be reinforced by the supports and by the reserve of " the skirmishing battalion."

Now if the front line of skirmishers (two or three companies) are found sufficient, without being reinforced, to drive the enemy from his position, it is clear that the defence must have been of such a weak

* Ruft Prince of Hohenlohe Ingelfingen, Major General Commandant of the Brigade of artillery of the Prussian Guard.

† The art of operating under the enemy's fire with as little loss as possible, by Major Tellenbach.

nature as not to require any very special disposition to be made against it.

As, however, the new attack formation has been introduced for the express purpose of neutralising the formidable difficulties which the defence of a position by troops armed with breech-loaders is supposed to present, it may I think fairly be assumed that the reinforcement of the front line will nearly always be necessary. This view is corroborated by the experience of the late war, for Boguslawski says that, "It happened frequently that soon after the beginning of an "action, a whole regiment (three battalions) fought extended into a "line of skirmishers, and that often the regiment in second line, if not "already directed to incline to the right or the left, was required to act "as support to the first."

At the critical moment then, as far as numbers in the front line are concerned, the only difference between the reinforced line of skirmishers and the two-deep line will be, that in the former every man will be out of his place, companies will be mixed up, and the difficulty of control and command over the troops under fire will be enormous, if not insurmountable; whilst in the latter all the companies will be intact and in their proper places, and the control and command precisely as usual.

It cannot of course be denied that the two-deep line, when it approaches within easy rifle range of the enemy's position, presents a target which it ought to be easy to hit.

A direct attack however upon a determined enemy can never be made without heavy loss, whatever the formation in which it is made may be, and until it can be shown that in making such an attack, the loss incurred by troops in the skirmisher-swarm formation is so much less than troops in two-deep line formation, as to entirely compensate for the mixing up, confusion and want of control which the former formation entails, I consider any such radical change in our tactical formation is clearly to be deprecated.

It is of course impossible to lay down arbitrarily any system of attack or defence, which will be applicable to all circumstances and to all kinds of ground.

I submit, however, for consideration the following form of attack for a single battalion, in order to show if possible that not only as a target, but also as a tactical formation, the line is superior to the skirmisher-swarm.

In advancing under artillery fire, the line, having necessarily to adapt itself to the formation of the ground, must try as far as possible, when it has to break up its component parts, to do so in such a manner as will still only present a two-deep line as a target.

Thus, if the fire upon the line be direct, an advance in short échelon will give the requisite flexibility, and at the same time in no way offer a more favorable target. Should the fire come diagonally from one flank of the position, an advance in échelon from the opposite flank will meet the requirements of the case.

It must entirely depend upon the severity of the fire and the formation of the ground, whether the advance under artillery fire shall be

general and continuous, or whether it shall be made by a succession of rushes. In the latter case, each company in succession would run forward at speed to certain distance, and lie down, each forming up in line on the one which precedes it.

By this means the first 1,200 yards ought to be got over without much loss.

During the last 800 yards, however, the advance becomes really difficult, and every possible means must now be taken to diminish the effect of the enemy's infantry fire which sooner or later must now come into play.

Rapidity of movement and a formation offering the most unfavourable target possible, are excellent precautions against infantry fire, but would not be sufficient to ensure a successful advance. Now, as formerly, skirmishers must cover the front, and upon them must devolve the arduous duty of protecting and aiding the advance up to the moment when the final rush upon the position has to be made.

A position defended by breech-loaders is now so strong as to necessitate its being approached in a manner somewhat like that which is laid down for the escalade of a fort or for the storm of a breach. The fire of the defenders must be kept down by troops specially told off for the duty, and this duty must devolve upon the skirmishers.

Skirmishers should thoroughly understand that wild, unnecessary firing is worse than useless, as it does the enemy little harm, and tends to give him confidence.

A steady, well-directed fire, on the other hand, kept up upon every man that shows his head above the cover of the position, will nearly invariably produce its effect, and will certainly tend to lessen the value of the enemy's fire, and thus facilitate the advance of the attacking force.

In order to cover the front of the line in the most rapid manner possible, and at the same time to give the line itself greater freedom of movement, I would recommend for consideration and trial, that the requisite number of skirmishers should be sent out from each company, so many from each section. Their numbers must be regulated by circumstances, but the advice of Boguslawski should not be forgotten, viz., "that skirmishers sent forward should be in force from the beginning, as bringing forward reinforcements always occasions great loss."

No supports or reserves will be necessary, as the line will be close behind them, and they are not intended as an attack formation.

Skirmishers when used to cover the advance of a line, should in my opinion only take advantage of such cover as each man may find in front of him. There should be no diverging to the right or left, and every effort should be made to prevent the men getting into knots and clumps, which inevitably draws down a convergent fire. A single skirmisher lying down in the open has really less chance of being hit than if he form one of a group, as in the former position he does not attract any particular attention.

The manner in which skirmishers should advance is a very important consideration; it should be carried out in such a manner as to secure a continuous fire being kept up, and also to admit of that fire

being delivered by them from such a position as will offer the smallest possible mark to the enemy.

When skirmishers advance in one general line, they offer the most favourable target to the enemy's fire, and they themselves have no time to fire steadily and effectively. Such a formation is therefore only suitable when the advance is made without firing, or when skirmishers are opposed to very inferior troops.

An advance by alternate files is not much better than a general line, and under fire would soon become one.

An advance by alternate sections of companies is better, but the unit is so small as to render the general control of the skirmisher-line very difficult. Moreover the advance of alternate sections cannot be covered by the fire of the halted sections, as the spaces between are so small as to render such an attempt dangerous; the fire must therefore be kept up by the skirmishers of the most advanced sections, who, as in a general advance, will have no time to fire steadily and effectively except by diminishing the rapidity of their advance.

The same principle which I advocate with regard to larger bodies, holds good, I think, for skirmishers, viz., that they should be divided into as large an unit as can be conveniently controlled.

In this view I would recommend for consideration and trial, that the skirmisher-line covering a battalion should be divided into four parts, one of which should be always advancing, the next to it ready to advance, and the other covering the advance by their fire. For instance, the skirmishers being divided into four parts, numbered from the right, are lying down. The advance, followed by the Commence Firing sounds, No. 1 at once rises and doubles forward about 20 or 30 paces; No. 2 remains lying down; Nos. 3 and 4 commence firing. When No. 1 lies down, it commences firing; No. 2 rises and doubles forward in line with No. 1; No. 3 ceases firing; No. 4 continues to fire.

No. 3 then doubles forward, whilst Nos. 1 and 2 keep up the fire, and, if thought desirable, No. 4 can advance at the same time.

When the skirmisher-line is thus reformed, another advance should be made in the same manner.

By this plan a continuous fire can be kept up by *halted* skirmishers on a good portion of the enemy's line, during the whole advance, whilst each man will have plenty of time to judge his distance accurately, and to deliver his fire with a steady, effective aim.

The advance of the line in rear must be regulated by the progress made by the skirmishers, and by the amount of aimed or unaimed fire to which it may be exposed. The nearer it can remain to the skirmishers, however, the better.

The whole line can rush forward as a single body; or, when the enemy's fire or the ground does not admit of this, it can be advanced, as already explained, by half battalions, double companies, or companies.

It is, of course, impossible to say how near, by the above method of advance, the line will be able to approach to the enemy's position. Unless, however, the enemy is a very contemptible one, sooner or later the skirmishers will be unable to get on any further.

When this check occurs, the line must be brought up to the skirmishers, who will thus fall again into the ranks of their respective companies; a general fire will be opened by the line from a lying down or kneeling position, and preparations for the last rush on the enemy will have to be made.

A charge in line, over a distance of even 100 yards upon a position stoutly defended by troops armed with breechloaders, may almost be pronounced impracticable, unless efficient means are taken to keep down the enemy's fire, or at least to diminish its effect. It is possible, of course, that the charge would succeed, but the loss of life would necessarily be very great.

The problem therefore to be solved is how to cover the final rush by an effective fire.

This important duty should, I think, devolve upon the two flank companies of the battalion.

Whilst the fire of the line is kept up, they should be moved out diagonally to the right and left front, and placed in such a position as will enable a cross and oblique fire to be brought to bear upon the enemy. The formation of these companies must depend entirely upon the ground, and need not necessarily be in skirmishing order.

So soon as the fire of these companies has produced an effect, the line should cease fire, and again get nearer to the position by a succession of rushes, opening fire again directly it is halted. The two covering companies, if not already far enough advanced, will take this opportunity of creeping on nearer. By this means it is hoped that the troops may be brought up to within charging distance of the enemy, when, if he still remain, recourse must be had to the bayonet.

An advance by a succession of rushes was successfully adopted by the Germans during the late war. Boguslawski says:—" Meanwhile " the German line of skirmishers was approaching the enemy by a suc- " cession of rushes. This was either done by taking advantage of " cover, or else they would advance about a hundred paces at a run, " throw themselves down, and then run on again."

Such a modification of our line formation seems to me to grapple with the difficulties of a direct attack far more successfully than does the skirmisher-swarm. It contains all the necessary characteristics of a good attack formation, viz. :—

a. Simplicity.
b. As large an unit as can be conveniently commanded.
c. Fire under good control.
d. The possibility of straggling reduced to a minimum.
e. Most unfavourable target for the enemy.

Moreover it does not require the extraordinary training laid down as necessary to ensure the success of the skirmisher-swarm formation, viz., the organization and regulating of confusion; the bringing of order out of disorder.

Hear what the author of a " Tactical Retrospect " has to say on this subject, he who was the first to recommend the skirmisher-swarm attack:—

"Confusion followed as a matter of course upon these attacks in "loose order."

"This mode of fighting has an invariable result, the original depth "of the order of battle which consists of a support behind the skir-"mishers and a reserve behind these, is now superseded by a greater "extension of the front line."

"There is not even the smallest guarantee that a company will fight "together with the skirmishers, which it has itself thrown out, or that "the companies of a battalion, or the battalion of a regiment, will "ever come together.

"After a short time not only the advanced guard and the main "body, but also a part of the weak reserve was engaged in the front "line; and the companies were all mixed up with one another in the "greatest confusion. Without the slightest necessity, one company "after another was hurled into the chaos of the fight; very soon all "were swallowed up in the front line, and thus all power of movement "was lost." "When the Hanoverians at length attacked these weak "lines with superior force, that happened which was inevitable, they "were broken and their component parts driven back. No reserve was "at hand, and thus any rallying was impossible."

The system, in fact, seems based on the assumption that victory is a certainty; and I have not as yet discovered any one who has ventured to lay down how the agglomerated mass of skirmishers when defeated is to be brought off the field, with any prospect of rallying the troops again in their original formation within a reasonable time.

The following extract from the same author will show how *he* shirks the question:—

"But it may be objected that such tactics will make it very difficult, "after the battle, to re-assemble the troops thus mingled together, in "their proper corps and divisions. First, gain your battle, that is the "chief point, then it will be far easier to disentangle and collect your "men into their proper places than after it is lost."

Want of order, and consequent want of proper control; undue extension of the front line, and the impossibility, in case of defeat, of quickly re-assembling the scattered units, are thus seen to be a few of the drawbacks of the skirmisher-swarm formation.

Still more serious defects remain to be pointed out. I again quote from "A Tactical Retrospect"—

"If only all soldiers, of their own accord would simply do their duty "in battle, an army would be perfectly invincible, and would not require "any tactical instruction whatever."

"But man has in his composition a natural desire of self-preserva-"tion—who would ever maintain that death was indifferent to him!

"The greater number of the men go bravely into the fight, because "their common sense tells them that it must be so, that it would be "shameful to sneak off: if they cannot do so with a good grace they "make the best of a bad bargain."

There will always be some, however, he points out, who but watch the opportunity to remain behind—

"So long as the soldier knows that the eye of his officer is upon

" him, he instinctively feels the inspiration and willingly bows to it. But " in the supreme moment in which danger and death are imminent, sud- " denly this accustomed link is broken, the eye of his leader is directed " towards the enemy in the front, the troops hurry towards the fire; the " man sees death in his front and a nice road-side ditch by his side; it is " the temptation to a theft, he sneaks quietly into it, and his company is " soon far away from him.

" This sneaking off in all kinds of ways is by no means a rare " occurrence. It is chiefly by these kind of stragglers that such a " serious melting away of many companies in battle is caused."

" The same man who, while overlooked, bears himself bravely, will " fall off when left to himself."

If this statement of the case be equally applicable to British as well as to Prussian troops, and I fear that none who have been in action will attempt to deny it, then it follows that any system by which the supervision over troops under fire is diminished, must tend to lessen the chances of success.

Encouragement of straggling, therefore, may also be added to the other disadvantages of the skirmisher-swarm formation.

The last but not the least objection which I have to bring against the skirmisher-swarm formation, is the necessity (produced by the undue extension of the front line), which is entailed upon the artillery, of firing over the head of the advancing troops almost from the very commencement of the attack. As the writer of Essay No. IV says:— " In firing over the heads of infantry, one shell bursting short amongst " the men tends more to demoralise them than fifty shells from the " enemy bursting in the same place would do. The confidence of infantry " in their artillery, which it is most essential to encourage, is ruined by " one or two accidents of that nature."

Firing over the heads of infantry should be the *rare exception*, not the rule, and should only be permitted " when artillery has already got " the range and from personal observation knows the points of the " ground in the enemy's fronts, which are endangered by it. When the " infantry approach those regions, the fire should at once cease."

I have thus enumerated the disadvantages which the several advocates of the skirmisher-swarm formation themselves must admit that it possesses.

Even amongst the Germans there is still considerable difference of opinion as to the formation best suited for attack, and in a work only lately translated from the German by Colonel Edward Newdigate, called " Experimental Tactics of (Prussian) Infantry in the year 1872," it appears that the line formation is mentioned as preferable to the column against artillery fire; and as a very appropriate formation for troops *when stationary!* " under the enemies' fire in case the ground " offers no cover!!"

The following passage also occurs in " A Tactical Retrospect:"— " It must be most distinctly understood that these loose irregular " formations which we have here alluded to, are not to hold good on all " occasions and in all circumstances. So long as an officer believes

" himself to be in a position to gain the same results by keeping to the " systematic forms of the service, he is quite right to do so."

In another well-known German pamphlet, entitled " On the Prussian " Infantry 1869," the following passage will be found:—

"In order to attack a position defended by breech-loaders, two " points must be taken into consideration; first, how to pass over the " distance of from 400 to 50 paces before the enemy, without being " annihilated; and secondly, how, under the circumstances, we may be " enabled to have the troops well in hand, in close order, at the moment " of the shock. The skirmisher-swarm attack might, perhaps, answer " for the first point of view, but decidedly not for the second."

Another authority on the late war, viz., the Duke of Wurtemberg says:—" One must, however, be cautious in drawing conclusions re- " garding the possible result of tactics in the future from what the " Prussians succeeded in doing."

It is evident that the adoption of the skirmisher-swarm formation was, as it were, the inspiration of the moment, forced upon the Prussians by the terrible loss which they suffered at St. Privat, when advancing according to the regulations which at that time held good. Success, one must remember, is apt to mislead, and it seems to me that superior numbers, entire disregard for loss of life and the faults of the French, had probably much more to say to the victories of the Germans than the tactical formation by which they were won.

Until, however, this moot point be decided, and the " individualised " method of fighting " be either authoritatively laid down for guidance or definitively rejected, it would seem well to consider how we can instruct our soldiers under our *present* system; so that if an European war were to come upon us suddenly, we should not be utterly unprepared to meet the altered requirements of the day.

It seems to me that it would be well to draw a broad line between the mere mechanical drill of the company and battalion, as laid down in our Field Exercise book, and its practical exemplification when troops are supposed to be moving under fire.

The one should be called Drill, the other Manœuvring.

When at drill, no skirmishers should be sent out to cover the movements, this should be reserved entirely for manœuvring.

There would, of course, be skirmishing-drill, as well as battalion-drill, but no combination of the two.

I attach myself the very greatest importance to steady drill, and consider that now, more than ever, it is essential not to neglect it. I cannot do better than quote in favour of this view, the words of a General Officer, who has been an eye-witness of the success of the Prussians in the campaigns of 1866 and 1870-71. He says:—

" Careful and accurate drill during peace is the best preparation for " celerity and steadiness in war:" " more than half the movements in " the best and most simplified drill book have no greater practical value " than to make the men ready, perhaps to provide for a case which " may arise once in a century, and to practise Officers in giving words " of command." " If all Officers and men were equally intelligent " and perfectly cool under fire, it might, perhaps, be sufficient to drill

"them only in such movements as would be used in the field. But "they are not; therefore careful and elaborate drill cannot be dis-"pensed with, *and those who think that because many field movements "are not, and cannot be practised, under fire, they therefore ought not to "be practised in peace or on the drill ground, are in my humble opinion "very much in the wrong.*"

I feel sure that the sound common sense contained in these few lines will carry conviction home to every soldier who has thought over the matter, and who may, perhaps, be doubting somewhat whether so much attention to drill minutiæ is really necessary.

With respect to manœuvring the same General says:—

"The German system, however, is well worthy of our imitation so "far as general principles are concerned. To quote the words of an "Officer who was present in the field during the late war,—'actual "'movements in the field as done by the Germans, are always as "'simple as possible, being guided by two common sense rules, to get "'to the place where you are wanted as quickly as possible, and in "'the simplest manner possible.'"

When a company or battalion is manœuvring, every movement should be made as if in presence of an enemy. The position of the latter should be pointed out, and if marked out by flags or by a few skirmishers, so much the better.

In the attack of the future, skirmishers must necessarily play a most important part. They should be made, therefore, to fully understand the purpose for which they are sent out, and the necessity of moving forward with the least possible exposure. When firing, they should remember that quality not quantity produces the most effect.

Skirmishers must never be recalled in order that the line may open its fire. The latter must move up to the former. They must be accustomed to move without sound of bugle. The words of command must be conveyed along the whole line by the Officers and non-commissioned officers. Troops in line when halted should at once lie down. Firing and loading should be carried out in the position entailing the least exposure to the enemy's fire, and the more especially when at easy shooting distance from the enemy's position.

An advance in line against a position defended by breech-loading arms and within easy range of them, must be looked upon as almost hopeless, unless it can be covered efficiently by the fire of special parties told off to keep the enemy's fire down. The fire of the flank companies, as I have already said, appears to me the best solution of this difficulty.

By some such means, and by many others which will no doubt suggest themselves to Commanding Officers of regiments, infantry may be at once taught to move in the manner, which will insure a minimum of loss under the fire of modern artillery and breech-loaders.

The separation of drill from manœuvring will, I feel sure, produce the most beneficial results, and will do much to prevent the somewhat absurd situations which now too often occur when a combination of the two is attempted.

Whilst I have thus endeavoured to prove that no radical change in

the tactical formation of our Army is really required, I have, I trust also clearly indicated the important changes in the movement of our troops when under fire, which I consider necessary.

Those changes, however, are simple and easily understood. They are merely an extension of our present drill, and do not entail the study of an entirely new system. They appeal to the intelligence of the soldier, and are calculated to give him an increased interest in his profession; and last but not least, they will enable us to retain, in spite of all the changes in modern warfare, that two-deep line formation for attack, which the British Army has always looked upon as peculiarly its own.

PRACTICAL METHOD OF FINDING A SHIP'S METACENTRE AT GREAT ANGLES OF INCLINATION.

THE accompanying paper has been written at my request by Mr. Blom, the Chief Constructor of the Norwegian Navy.

Its great importance will be recognised at once.

When ships were constructed with high sides and unarmoured, the importance as regards their safety, of ascertaining their stability, both when they existed in design, and afterwards when the position of their centre of gravity had been ascertained *experimentally*, was not great; but now no class of gun-boat, however small, no class of ironclad, however large, is allowed to go to sea until the curve of stability, of one sample at least, is ascertained. Hitherto the calculations have necessarily been very lengthy. In evidence given at the Court-martial on the "Captain," it was stated on the best authority,—that of Mr. Barnes, to whom we owe the investigation,—that it required a whole month for two experts to complete the calculations. It will be remembered that Mr. Laird had the moment of stability of the "Captain's" design calculated for one angle of heel only (10° I think) before the ship was constructed. Had so short and simple a method as Mr. Blom's been known to him then, it is pretty certain that he would have had it calculated for other angles as well, and then, that the "Captain" would reach her angle of maximum stability at 23°, and lose it entirely at 54°, would have been disclosed. This startling fact would have led no doubt to the ship being tested to ascertain *experimentally* the position of her centre of gravity *immediately* after her arrival in a Government dockyard; and if the previous calculations had been confirmed, she would probably have had her masts removed or reduced to a jury rig.

I mention the above to prove what a boon Mr. Blom has conferred upon naval constructors and upon those who "go down to the sea in ships." His modesty has prevented the introduction of his method to the world before now. He mentioned it casually to me when I professionally visited a few weeks since the Royal Dockyard of Horten in Norway. The curves of stability of the Norwegian monitors and converted gun-

boats have been ascertained in this way and its accuracy tested by comparison with the results of the vigorous but very lengthy method.

ALFRED P. RYDER,
Vice-Admiral.

Having had to calculate the curve of stability of ships of rather peculiar forms, such as monitors, according to the plan of John Ericson, I have found the regular way, described by Mr. Barnes in the Transactions of the Institution of Naval Architects, less serviceable on account of the want of continuity of the transverse sections of the ship, besides being very laborious; and I have been induced to use a different way for finding the metacentre, or rather the statical stability of a ship for angles of inclination, where the metacentre may not any more be supposed the same as in the upright position of the ship.

The problem of finding the metacentre at a given angle of inclination is solved, if only the movement of the centre of buoyancy of the ship in a direction parallel to the inclined water-line, is known. This is what I find in the following way:—

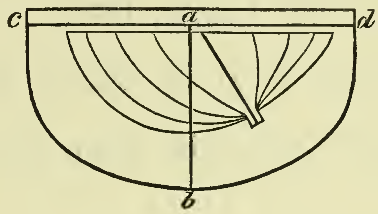
I at first determine the position of the inclined water-line of the ship in the body-plan by first drawing it at guess so as to make, according to eyesight, the immersed and emersed wedges equal, and afterwards correcting it by calculating the immersed and emersed volumes and dividing the difference between them by the area of the inclined water-line; the quotient giving the quantity the assumed inclined water-line is to be raised or lowered, according as the emersed or immersed volume is in excess.

To make the last-named calculation in the easiest way, I measure the immersed and emersed areas of each cross-section, either by a plainmetre or by a transparent paper of squares; then take the sum of the immersed and of the emersed areas separately, subtract one from the other, and divide the difference by the sum of the breadths of the supposed inclined water-line at the different sections, taking only one-half of immersed and emersed areas and of the breadths of the inclined water-line *at the end stations*, if these may not be altogether neglected as they generally may; the quotient is the above-mentioned correction in the height of the inclined water-line.

I next have a set of models of the different transverse sections of the ship, drawn in the body-plan, cut out in paper. The paper models are carefully put on the top of one another with their middle line and upright water-line corresponding, and then secured together by a light stitch of thread in two places. The inclined water-line is drawn on the top of the parcel, which is then cut in two through this line, the lower part representing the displacement in the inclined position of the ship.

I now find a line $\perp$ to the inclined water-line, in which the centre of this displacement is situated (viz., the centre of buoyancy in the inclined position) by balancing the parcel on a horizontal, sharp, straight edge, *a*, *b*, placed at right angles to a vertical plane, *c*, *d*, as shown in the adjoining sketch. When the position of equilibrium of the parcel on the edge, *a*, *b*, is found, keeping the inclined water-line parallel to *c*, *d*,

the position of a, b is marked on the parcel by pressing it hard against the edge; the line, a, b, is then transferred to the body-plan, by putting the parcel of paper models on the top of it, and prolonged till it intersects the middle line in the metacentre. When the centre of gravity of the ship is marked in the body-plan, its perpendicular distance from the line a, b at once gives the lever, on which the weight of the ship is acting to right or upset the ship, and these levers for different inclinations are the ordinates of the now generally known *curve of stability*.



It will be seen that the correctness of this method is founded on two conditions, viz., 1stly, that the centres of gravity of the paper models coincide with their centres of figure; and 2ndly, that the weight per square unit of the different models, is the same. I have found that common drawing paper can be had of sufficient uniformity to fulfil these conditions with the degree of exactness required for practical purposes. It will further be seen that the method is an application of the trapezoidal rule for calculating the centre of gravity. To make this rule sufficiently correct, I generally divide the length of the ship into 16 parts, which gives 15 intermediate sections, besides the two end sections which are neglected.

I have by experience found the above-described method to give a sufficiently exact result, when it is executed with neatness; it has the advantage of saving a great deal of mental work and of time. As soon as the inclined water-lines, corresponding to the different angles of inclination, have been determined, the process is only a mechanical one. The figure of the sections may easily be pricked through from the original body-plan, cut out and put together by a number of assistants so that in one or two days the curve of stability can be got out.

TH. A. BLOM.

Norway, June 1873.

THE BATTLE OF WÖRTH.

6th August, 1870.

By Lieut. E. H. H. Collen, R.A.

(Staff College Prize Essay, 1872.)

Preliminary Observations.

If it be neither necessary nor desirable to enter upon a lengthy disquisition concerning the political history of the Franco-German War of 1870–71, we cannot afford, on the other hand, to neglect the salient points of the attitude of the belligerent powers prior to the declaration of war.

The plan of any great military operation is invariably dependent upon political considerations. This is the true key to nearly every military problem of any rank in the history of the world, the solution of which has been attempted by war.

The military writer, therefore, who desires to study and depict the operations of war in their greatest breadth of outline, must obviously endeavour to grasp the political situation of the warring nations, in order that he may form a judgment on the strategical plans, and on the power of either side to take the initiative in the campaign.

Beyond this, he must make himself acquainted with their military systems and resources. In attempting this difficult task, we feel ourselves still dazzled by the bright light of the great events which seemed to flash past us, in a course so vivid as to outrun history.

The war of steel and shot has been followed by a war of pamphlets, and the military student who tries to gain information concerning the political basis of the war, recoils at last, wearied out by accusation and counter-accusation, only finding relief in that portion of the mass of writing, which treats of the military systems of France and Germany, and where each side agrees in condemnation of the former and laudation of the latter.

Political Considerations.

On the one hand, we are told that the Germans are a peace-loving people; and that the sudden uprising of their armed million only

demonstrated the greatness of the quarrel which was forced upon them by an unjustifiable pretext.

On the other, we learn that no one in France really desired war: that each General (except the Minister of War) knew the weak points in her armour; that the ancient foe of France gladly seized the opportunity offered by bad diplomacy to put her in the wrong at the outset, and that France, unable to bear the passive insolence of Prussia, was, in the interests of national honour, obliged unwillingly to throw down the gage of defiance.

Are we able to determine upon whom rests the responsibility of entering first into the terrible lists where Death stands the arbiter?

The calmer judgment of future time may be able to reply.

It will be sufficient for us to express the moderate belief, that blame rests upon both the Governments of France and Germany.

In the one country, war was desired by a party, which saw in successful military enterprise, the only way out of the difficulties entangling an Imperial Government. The old cries of "national frontier," and national honour were raised, the military passions of the dominating Parisians were inflamed, and the more moderate and peaceful counsels of those who shrank from an appeal to arms, were drowned in the shouts of mistaken patriotism.

In the other land, a great statesman had long been preparing for the struggle which he foresaw must come to pass between two great military powers, both possessing enormous armaments, and both desirous of holding the reins guiding the destinies of Europe. A military despotism was to be maintained and propped up by military success; while the liberal ideas, beginning to undermine the system which has of late years placed Prussia among the foremost nations of the world, were to be thrown back, and yield themselves captive to the fascinating temptation of martial renown. The dream of German unity was to be realised, and parties and peoples were to be bound together by ties more potent than those of ordinary commercial and political interest. The memories of past oppression were to be invoked, and the divisions of the German race were to be united against the common enemy.

On the French side, since the time war had been tacitly determined upon, if openly disavowed, the probable demeanour of the South German States was anxiously canvassed. Upon this demeanour hung the French plan, conceived under mistaken belief both of the behaviour of those States, and of the power and accuracy of organisation, which would enable France to seize the advantage of the initiative and carry war into the enemy's country.

Every indication, military or political, shows us that offensive war was intended, and that the original idea, was the passage of the Rhine, the separation of Southern from Northern Germany, and the assumed consequence, alliance with Austria and Italy.

We are told in a pamphlet which bears the stamp of authority, that this plan was to compensate for inferiority of numbers; and its audacity of conception might command our admiration, if it had been accompanied by a just appreciation of the military power of the foe.

But the political basis was insecure. No real grounds existed for the belief that the South German States would remain passive spectators of the invasion of their soil, or would unite with France against Prussia.

In 1866 the South German States had been hostile to the cause of Prussia against Austria. The Peace of Prague, however, accomplished great things towards German unity. The retirement of Austria from interference in the government of the German States; the abolition of the Diet; the great strengthening of the hands of Prussia by the annexation of Hanover, Hesse-Cassel, Nassau, and Schleswig-Holstein; the formation of the North German Confederation, and the *military subordination* of the armies of the South German States to the King of Prussia, should war arise; all combined to work together in the direction so much desired by a large party in Germany. The Customs treaties, and the various commercial relations subsisting between North and South Germany were enlarged. In a word, the military domination of Prussia was established, and in a manner which rendered a large party desirous of binding themselves in a great German Confederation, at the head of which should stand the power of Prussia.

It is difficult to believe that the course of events in South Germany could have been watched closely by French diplomatists, if we credit the statement which affirms, that up to the last moment the French Foreign Office believed that the South German States would join the invader, and prefer to fight or passively acquiesce, in the struggle, in military subordination to a foreign and alien power, rather than make common cause against the common enemy.

The spirit of peoples is but the embodiment and gathering up of that which animates individuals, nor did it require a profound knowledge of human nature to determine that the balance of probability lay on that side of the political argument, which asserted that the South Germans were more likely to unite against a foreign than a domestic foe.

The French Army.

In the French Army matters were scarcely in a good state for opening a campaign. The lines of demarcation between Officers and men had been gradually softened, and the bonds of discipline relaxed. The minds of the thinking Officers of the French Army, were unsettled in regard to the many important questions in tactics which the changes of late years have brought forward; and this want of stability naturally reflected itself upon the great masses of the men. A system of enlistment which did not give sufficient men for the reserve, and the dependence upon a huge untrained levy, the Garde Nationale Mobile, united to hinder the production of a military force adequate to a struggle with Germany.

In 1866 the reorganization of the Army had been commenced by Marshal Niel, and the new law of recruiting was a vast improvement on the Army systems successively inaugurated by Gouvion St. Cyr, and

Marshal Soult in 1818 and 1832, which had hitherto obtained as the basis of martial preparation.

The change became law in February, 1868; but after the death of Marshal Niel in August, 1869, the reforms were carried out in a feeble and perfunctory manner. Still, something had been accomplished, and public opinion was ready to applaud and be satisfied by the wonders which the Chassepôt was to work in future war, while the mysterious mitrailleuse was accepted as a great military discovery which might revolutionize tactics.

Few, moreover, cared to look into the dry details of military organization. *The French system was one which required time to develop its strength.* Brigades and Army corps were not maintained in a form which admitted of easy transition to a war-footing. In 1870 two corps alone, those of the Guard and of Chalons, were embodied. Neglecting the natural plan of localization, and territorial distribution, which the Prussians had adopted, the outbreak of war brought with it the necessity for absolute reorganization, a vastly different matter from the process of "mobilization." Men had to go long distances to join their corps, and the depôts for equipment were in some cases far from the points of concentration. The military resources of the country were centred at Paris, Lyons, Marseilles, Metz, and Strasburg; the magazines were in the front line of danger, and further than this, the power of applying these resources was wielded by a distant authority at the War Ministry.

Military Administration.

The civil administration of the Army swells the list of defects in the French military system. It would, however, be most unphilosophical to follow the cry which rejects everything French as worthless, and extols the military preparation and feats of arms of their adversaries in blind admiration. We had long looked to the French system as the perfection of military organization. The War Ministry of France was held up as a model to be copied in Pall Mall. The smoothness and regularity with which all was worked, were commented upon, and we were shown how excellent was *the concentration of the whole military business of the country under one single head.* The Corps de l'Intendance Militaire was deservedly admired, and the views held by some of our most able Officers were very favourable towards the French system. And not without reason; the Intendance had done excellent service in Africa, the Crimea, and in Italy; the Officers were men, for the most part, of capacity and activity, selected for their talents, and enjoying high consideration. The Transport Service, represented by the Train des Equipages Militaires, was well organized, and had received considerable commendation from independent criticism. Officers of the British Army were, however, not wanting to note defects in the system.*

* See note by Col. Claremont, C.B., Military Attaché at Paris, in Lord Strathnairn's Committee Report, Transport and Supply, 1867, and evidence of Sir G. Balfour.

The one grand defect was *over-centralization*, and the *attraction* of work to the War Ministry which should have been decided locally. Apart from the influence which is said to have corrupted some of the employés of Government, we believe it will be found that the above is the key to the French failure, and the defects of the *personnel* of the Intendance were comparatively minor.

In peace-time, business flowed quietly through the "proper channel," was received into the official mill, and after receiving "due consideration," was diverted into the course which led to ultimate action being taken in the matter. The machinery was well oiled, much trouble was saved to subordinates, and the power of the War Ministry was increased. But when the rude trial of war came, the machine was worked to its highest pressure, the channels were choked to repletion, and the machinery was thrown out of gear.

No greater lesson can be presented to the minds of the present generation in the absolute dependence of all modern war, upon military administration. The military business of the country was centred at Paris; for every work a Ministerial order was necessary, and the wise remark of Marshal Bugeaud was neglected or unheard: "On perd de "vue dans la paix les exigences de la guerre, et on fait les armées pour "la paix."

It has been asserted that the French Generals were not good military administrators. If they had been, their efforts would have been fruitless, for under the present conditions of warfare, time does not allow for reorganization.

Such may be held to be some of the reasons why France was enabled only to bring about 200,000 men in front line against the crushing masses of her adversary, while she had at the utmost only 300,000 trained and disposable troops. But France and her Government had received warning. Niel, Thiers, and Trochu had lifted their voices in vain. Stöffel had explained the German system with exhaustive ability, and had clearly pointed out the disadvantages of the French system in comparison with the merits of the German.

These men laboured to disabuse the popular mind of its blind self-confidence, and the prophetical writings of Trochu and Stöffel stand a monument to the folly of military vanity in past glories. They were passed by in silence and indifference, or treated as coming from dangerous disturbers of the peace.

If the Emperor Napoleon III was not desirous of entering upon the war, and we may well believe it, he must yet be held responsible for the culpable ignorance shewn by his War Minister, Marshal Le Bœuf. It was soon to be found out how even the military qualities of the Empire were disastrous failures. In brief, the Empire may have been peace,* it certainly was not war.

The German Army and its Military System.

If we examine the military system of Germany, we find it possessing those attributes and qualities in which that of France was deficient.

* "L'Empire c'est la Paix."

Strict discipline, strong distinctions between officer and private, a high military education for both, large reserves of trained men, the development of individual intelligence combined with the cohesion of the single forces constituting martial power, and, above all, a decentralisation in administration and organisation, appear to be the leading features of the system, which, judged by the standard of success, seems to have closely approached human perfection. If the subject of this essay were the military organization of Prussia, it would be necessary to turn to the pages of history, and trace the growth of a system whose seeds were sown in the bitter experiences of Jena and Auerstadt, to bear fruit in the triumphs of 1866 and 1870–71.

Time, however, is wanting for this purpose, nor can we do more than touch upon the principles of that organization which, as has been well said, has made, not so much an army for the nation as a nation for the army.

The standing army of Prussia consists of the Active Army, the Reserves, and the Landwehr, and in this order denotes the passage of the army contingent taken from the population; from the one portion of the whole force to the other during the twelve years of service. Very curious ideas were entertained in this country with regard to that section of the force called Landwehr, and we were bid to look abroad and see what could be effected by a militia, the moderate objection to the employment of the term "reserve," instead of "auxiliary," (an objection now officially recognized,) being placed to the account of professional jealousy.

The territorial division of Prussia and its dependent States, the formation of corresponding army corps, each tactical and administrative unit complete in itself, the power of mobilization obtained by the system, have become familiar to us, and need no consideration in this essay.

In Prussia all interests are subordinated to military development. Mars and not Plutus is the god of society, and the sacred enclosure may more easily be entered by the steel than by the golden key.

In all the various branches of industry applied to war, Germany was well prepared for the great campaign. A country largely productive of grain, she has within herself the staple of human subsistance. The breeding of horses for military purposes is carried on, and under the army-corps system, the various essential requirements in *matériel* are procured, stored, and issued with facility. In administration as in tactics, the commanders of these corps are treated as responsible beings in whom a great trust is confided, and they are *educated up to that responsibility*, which is not fettered by central authority, nor confused by the countless orders of a directing power ignorant of local requirements, and, as in the case of the French War Ministry, oftentimes framed on knowledge obtained in theoretical official minutes.

In the war of 1866, Prussia had marshalled her forces victoriously against a powerful foe. She took counsel upon the errors and defects which were then displayed, and her able head-quarter staff, endeavouring to crush outside criticism by the weight of authority, were yet wise

enough to profit by the advice which they appeared to neglect and despise.

The foregoing are some of the features, and which can merely be indicated in this essay, of that system which has for sixty years formed the study and care of successive soldier-statesmen in Prussia. Wrought by years of toil, springing from national disaster, it has been gradually elaborated until it has reached a point high enough in the scale of destructive perfection to command the deepest adulation of its friends, and the unwilling admiration of its foes.

The Military Topography of the Theatre of War.

To comprehend, with any degree of accuracy, the military operations of the whole or part of any stragetical plan, it is necessary, beyond an acquaintance with the political situation of the hostile countries and the organization and power of the opposing Armies, to master the *terrain* upon which those Armies are to meet. It will be right, therefore, to obtain an accurate view of the nature of the country, the mountains, rivers, communications by rail and road, and the fortresses situate in the theatre of war. We shall then be in a position to speak with some confidence upon the bases of enterprise, the lines of communication, and the general plans of the respective Staffs, and further to discuss the strategical and tactical situation of that fraction of the French Army which forms the especial subject of this essay.

The frontier which separated the two countries may be taken as extending from Sierck on the Moselle, in a S.E. direction to Lauterburg, near the Rhine, thence by the course of the Lauter to the former river, and by the Rhine in a S. direction as far as Basle. On the N., extension for purposes of invasion is barred by the neutral territory of Luxemburg. On the S. by Switzerland.

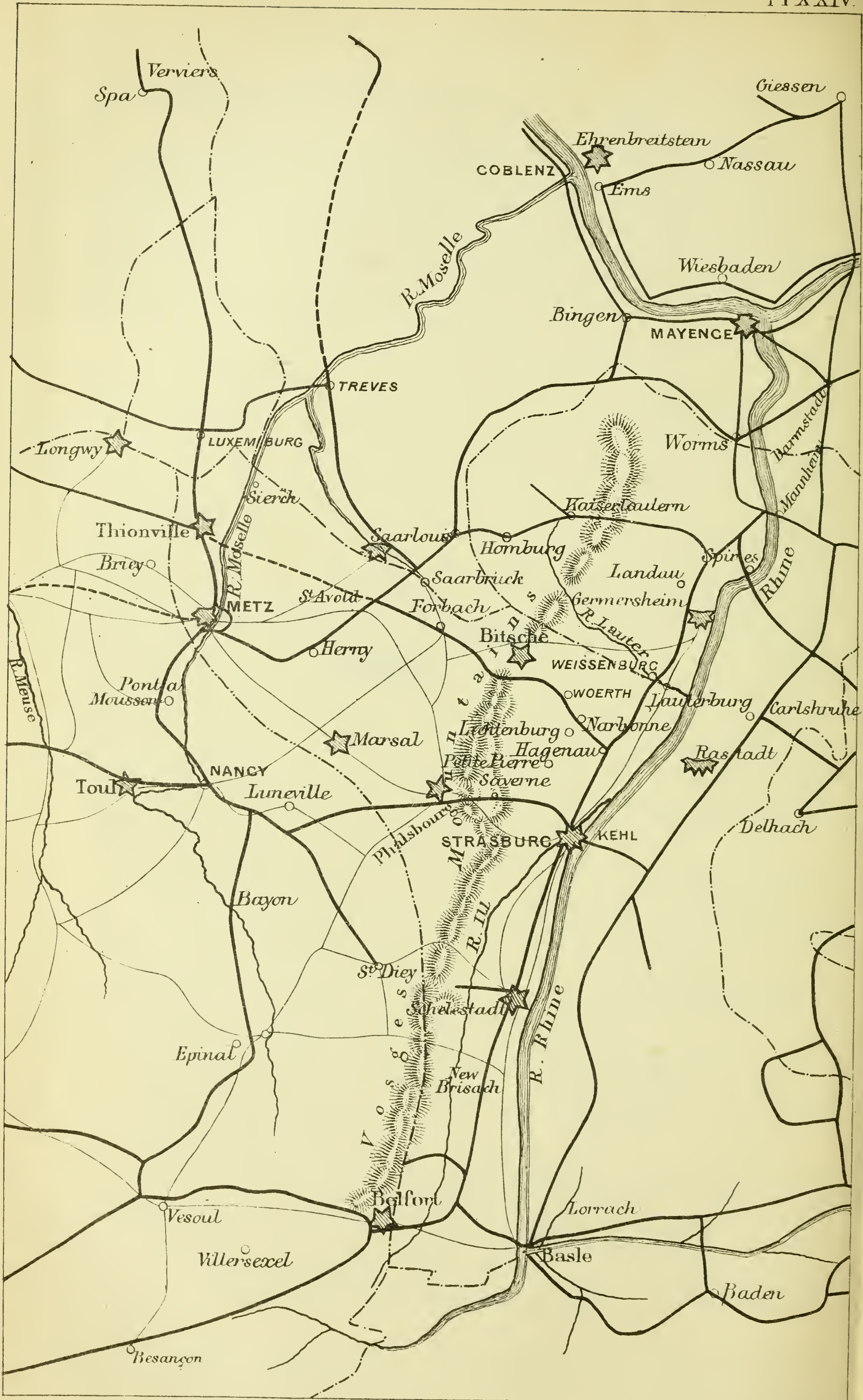
The frontier, therefore, was *re-entering* for the German side, and *salient* for the French, the apex of the angle being at or near Lauterburg. We shall presently have to remark upon the advantages this form of frontier conferred upon the Germans.

In geographical terms the theatre of war was, in the first instance, comprised by the basins of the middle Rhine and the Moselle, separated by the water-parting line of the Vosges mountains.

The basin of the Middle Rhine may be taken to mean the country drained by the course of the Rhine from Basle to Wesel. But for our purposes we must be content with that portion which lies on the left bank as far as Cologne.

The left portion of this basin is hemmed in by the Vosges Mountains, which speaking roughly run parallel to the Rhine, and extend from near Belfort to the Donnerberg (Mont Tonnerre), W. of Worms, there separating into the two branches, the Hardt (in which is Mont Tonnerre), in Rhenish Bavaria and Hesse, and the mountainous country between the Rivers Nahe and Moselle, known as the Hunsdruck and Hochwald.

Numerous small streams which rise in the Vosges, flow into the Rhine after a short course and are not strategically valuable as defensive lines, but rather as avenues of approach from Germany. In their course


Verviers
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COBLENZ
Nassau
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MAYENCE
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LUXEMBURG
Worms
Darmstadt
Mannheim
Sierch
Kaiserlautern
Thionville
Saarlouis
Homburg
Briey
Saarbruck
Landau
Spires
Rhine
R. Moselle
Germersheim
St. Avold
METZ
Forbach
R. Lauter
Bitsche
Herny
WEISSENBURG
R. Meuse
Pont à Mousson
WOERTH
Lauterburg
Carlshruhe
Narbonne
Lichtenburg
Marsal
Hagenau
Rastadt
NANCY
Petite Pierre
Saverne
Toul
Luneville
Delhach
Phalsbourg
STRASBURG
KEHL
Bayon
R. Ill
St. Diey
Schelestadt
Vosges Mountains
Epinal
New Brisach
R. Rhine
Belfort
Lorrach
Vesoul
Basle
Villersexel
Baden
Besançon

J. Jobbins

near the Vosges, however, they offer tactical positions in advance of the passes through which they flow.

In the S. portion of this basin, the streams from the Vosges flow not into the Rhine, but into the River Ill, which is a tributary of the greater river, rising S.W. of Basle, and flowing in a somewhat parallel direction until it enters the Rhine above Strasburg.

The first stream of any importance is the River Zorn which, rising in the Vosges, runs by Saverne, and unites with the River Moder, which latter also rises in those mountains, receiving several streamlets, and washes Hagenau, both entering the Rhine in one stream near Drusenheim.

The next is the *Lauter*, which, rising in the Vosges, flows near Pirmasens, Weissenburg, and Lauterburg.

The more northerly rivers, Rhine tributaries, need not be mentioned here. In many cases they mark the course of roads which would be used in an invasion of France from Germany.

The Rhine itself is an important military obstacle of which the Germans held the main issues, while those in possession of the French on the S. portion were neither so numerous nor strong. Beyond this, the issues on the French side conducted only, that is directly, into the difficult and mountainous tract known as the Schwarz-Wald or Black Forest, and its continuation. *On the other hand the German issues of Coblentz and Mayence turned the line of the Vosges Mountains.*

There were permanent bridges of boats at Strasburg, Fort Vauban (a ruin), Germersheim, Spires, Mannheim, Worms, Mayence, Coblentz, and Cologne; and railway bridges at Strasburg, Mannheim, Mayence, Coblentz, and Cologne.

The basin of the Moselle, itself a tributary of the Rhine, is formed on the E. by the Vosges, and on the W. by the Mont Faucilles, the Monts de la Moselle as far as Toul, and the Argonne and Ardennes' hills, which to the N. join the Eifelgebirge, whose E. direction compels the Moselle to enter the Rhine at Coblentz.

On the right bank the tributaries of the Moselle are of considerable size, on the left they are unimportant.

The Moselle rises on the W. side of the Vosges near the highest point of those mountains, the Ballon d'Alsace. It has a tortuous course of about 286 miles, with a mean breadth in France of 240 ft. It washes Remiremont, Epinal, Toul, Frouard, the junction of the Paris, Metz, and Strasburg railways, and where the River Meurthe joins the Moselle, Pont-à-Mousson, Metz, Thionville, and Sierck, at which latter point it leaves France. The Moselle forms a base of enterprise for France for offensive purposes, or a line of defence; but it is too far advanced as a base of defensive operations.

Its principal tributaries on the right or east bank are the River Meurthe, which rises in the Vosges, and passes by Nancy, the Seille rising in a long W. spur of the Vosges, and flowing by Marsal to Metz through a marshy country; the Sarre also rising in the Vosges, running past Sarreguemines (Saargemünd), Sarrebruck, Sarrelouis, and Sarreburg, entering the Moselle near Trèves.

The Vosges Mountains extending, as has been mentioned, from near

Belfort to the sources of the Lauter where they divide in a N.E. and N.W. direction, have a length of about 170 miles. The most difficult part of the chain lies between the Ballon d'Alsace, about 4,000 ft. high, to Mount Donon, which has an altitude of 3,200 ft.

These Southern Vosges are densely wooded, wide, and are a more serious obstacle to military operations than those of the north. The chief roads of this S. section, are:

1. Epinal, Mulhausen by the defile of the Moselle.
2. St. Dié, Colmar by the pass of Bonhomme.
3. St. Dié to Schelstadt by the defile of Ste. Marie-aux-Mines.
4. St. Dié to Strasburg by the defile of Schirmeck.

The N. Vosges, above Mount Donon, are less mountainous in character, but are much wooded and broken up by ravines. The E. slopes are more difficult than those of the W., and the width of the chain in the N. portion is not more than 20 miles on an average; the S. mountains having a breadth of about 30 miles.

The N. portion terminates in the hilly country, the Hardt, trending towards Mayence; that of the N.W. towards the Moselle, and ending near Coblentz.

The Northern Vosges (above Mount Donon) more immediately concern us, and we must examine more closely the communications across. They are:—

1. Saarburg, Phalsburg, Saverne, Strasburg, by the pass of Phalsburg.
2. Hagenau to Bockenheim (Saar-Union) by the pass of Lützelstein (la Petite Pierre).
3. Hagenau to Saargemünd by Lichtenberg.
4. Hagenau and Weissenburg, Niederbronn, Bitsche, Saargemünd by the pass of Bitsche.
5. Landau, Zweibrücken (Deux Ponts).
6. Kaiserlautern, Mannheim.
7. Saarlouis, Kaiserlautern, Mayence.

Besides these main roads there are numerous smaller country roads and tracks. It may be convenient to remark in this place that the roads in this part of the country, even those known as secondary and field-roads, and not main *chaussées*, are remarkably good, and easily traversed by all arms.

With regard to the passes themselves, they offer good positions for the construction of field-works, and the retardation of a superior force by an inferior one. While no absolute defence could be made for any length of time on account of the bye-roads and tracts leading over the mountains, the main *chaussées* could easily be blocked so as to afford time to a defending army to concentrate at any point in rear of the mountains. The passes over the N. portion of the Vosges are on an average about 1,000′ above the sea, so that their height above Alsace would vary from 600′ to 800′.

On the E. of the Vosges lie the plains of Alsace stretching to the Rhine, undulating and intersected by the streamlets of the Vosges flowing towards the great river. The country is wooded, but in many parts open, and rich in cultivation.

On the W. of the Vosges the hilly country of Lorraine extending towards the Meuse, has an altitude above the sea two or three hundred feet superior to the plains of Alsace.

The roads E. of the Vosges traverse these mountains E. and W., affording communications between France and Germany, or between the basin of the Rhine and that of the Moselle. E. of the Vosges they are connected by the main *chaussées*, Mayence, Landau, Hagenau, Strasburg, and Mayence, Spires, Lauterburg, Strasburg.

On the W. side of the Vosges, the roads direct on Nancy and Metz, while more northerly in the lower valley of the Moselle the roads are difficult, and on the tops of hills.

The railroads are as follow:—

On the N. and W. of Vosges—

1. Metz, Forbach, Saarbruck.

Whence lines diverge to Trèves, to Bingen on the Rhine, and by Homburg viâ Kaiserlautern to Spire, Mannheim, and N. to Mayence, connecting also with Germersheim S.

2. Metz, Sarreguemines, Bitsche, Hagenau, Strasburg.

3. Metz, Nancy, Luneville, from whence a railway branched to St. Dié; the main line from Paris running viâ Brumath to Strasburg.

4. Metz, Verdun, and Paris line. The portion from Verdun to Metz was not finished.

Hagenau, Weissenburg, Landau, Spire were also connected by rail.

5. Nancy was connected with Paris, and also viâ Epinal with the S. of France.

6. Strasburg, Colmar, Mulhausen, Altkirch, Belfort.

7. Metz and Nancy were connected on the left bank of the Moselle.

The last section of this part of the subject is the *fortresses*.

On the French side, the country between the Vosges and the Rhine, Strasburg is the only fortress of any importance, as the others may be neglected. The Fort of Bitsche is naturally strong and commands the road, but it is commanded with modern artillery from neighbouring hills. The Forts of Lützelstein and Lichtenberg either lie off the road or are of too ancient a date. The Fort of Phalsburg lies 2½ miles off the line of railway, and is too small to possess any power of attraction. Passing to the line of the Moselle, we find Toul, Metz, and Thionville the fortified points. Of these, Toul was of no great strength, and is commanded on all sides. Metz was a first-class fortress, containing schools of artillery and engineering, arsenal of construction, gun foundry, powder works, laboratory, and, in fact, all the manufacturing establishments necessary for the supply of all *matériel* of war and equipment to an army in the field. Protected by a very strong *enceinte*, one of Cormontaigne's greatest works, and through the ditches of which the Moselle flows, it was to be rendered a vast entrenched camp, by the construction of detached forts. These, however, were not all finished, and the connecting and minor forts were altogether wanting.

Thionville was only important as a *tête-de-pont*.

On the German side, we see the issues of the Rhine in its lower, middle course held by the great fortresses of Cologne, Coblentz, and

Mayence. On the more southerly portion, Rastadt is the only place of importance. Saarlouis, Landau, and Germersheim do not possess any strength to give them a real military value.

General Strategical Considerations.

We must now pass on to a brief review of the various courses of strategical action which were open to the Armies of France and Prussia.

Eliminating a consideration of the advantages which would accrue to France by offensive movement towards the lower Rhine, for the reason that action in this direction is barred by the neutrality of Belgium and Luxemburg, we may fairly agree with French and German writers, who are unanimous in the declaration, that quick offensive operations upon South Germany would have been the best course for France to pursue.

Prior to the war, there were not wanting German writers who declared that the extension of the German, or rather Prussian, military frontier southwards was an element of danger, and that a maritime attack would paralyze the defence of the Rhine. It certainly seems reasonable to suppose that the military co-operation of South Germany would thereby be nullified, and several German *corps d'armée* would have been completely disturbed in their efforts of mobilisation.

Invasion of Germany by the valleys of the Sarre and Moselle may also be placed aside, in company with the idea of an offensive movement towards the Lower Rhine. The operations of a large Army would be difficult, the communications being restricted. The country on the right bank of the Moselle is hilly, and the movement would bring the invading Army in front of Mayence and Coblentz. A further reason exists against this direction for invasion in the fact that there is only the railway, Metz-Saarbruck-Bingen, by which the French Army could be supplied.

We may, therefore, fairly consider that for France offensive movement above Mayence was the only course open, if invasion of Germany was determined upon.

French Plan.

The foregoing considerations doubtless formed the basis of the French strategical plan, and which is held to be as follows :*—

To concentrate 150,000 men at Metz, 100,000 at Strasburg, and 50,000 at Chalons. The first Army on the River Sarre, and the second Army on the Rhine. The enemy would be unable to determine whether this concentration was intended against the Rhenish Provinces or against Baden. The union of the Army of Metz with that of Strasburg was then to follow, and the Rhine was to be crossed at Masau, leaving Rastadt on the right and Germersheim on the left. The division of the 3rd, or Chalons Army, was to protect the rear and observe the N.E. frontier. Great political results might be expected from this course of action. The Southern German States would be obliged to observe

* "Campagne de 1870. Des Causes qui ont amené la Capitulation de Sedan." Par un Officier Attaché à l'Etat-major-Général.

neutrality, and the first French successes might obtain the alliance of Austria and Italy.

The French base of operations would, in this case, be the line of the Moselle from Metz to Nancy, and Strasburg. This base possesses several advantages. Metz and Strasburg are large fortresses and arsenals, and they were supposed to contain within themselves every means for the supply of an army. Nancy is the chief town of the department of the Meurthe, and is directly connected by rail with the capital. Metz, Nancy, and Strasburg, are connected by railway, and a good road.

Operations from this base would naturally take place on the following lines of communication, converging on Frankfort-on-the-Main.

1st. Metz to Mannheim by Sarrebruck, Kaiserlautern, Neustadt, both by rail and road.

2nd. Nancy, Saverne, and along the left bank of the Rhine, by the two great roads and railway mentioned at p. 435, leading on Mannheim.

3rd. Strasburg, across the Rhine, leaving Rastadt on the left, and moving on Stuttgardt.

Besides these main lines, there are intermediate roads from the base of operations leading across the Vosges, by which the country between the Vosges and the Rhine would be reached. The advanced German work of Saarlouis might be neglected, for it was not armed, while Landau and Germersheim possess no military strength. This plan has the advantages of turning the strong places of Mayence, Coblentz, and also Rastadt, and a secondary base might be found at Spire, Mannheim, Worms.

It appears to us, however, that the movement on Stuttgardt, and the subsequent wheeling movement which would be necessary to confront a Prussian Army on the Main, would give too much time for the concentration of that army. In pivoting on their left, the French would have to form front for battle, parallel to their line of communications with their base. Paris would also be uncovered, but this would be of secondary importance if the French could assure themselves of bringing superior numbers against the first Prussian concentration, and of obtaining a great tactical success.

If this reasoning be permitted, it would seem that the passage of the Rhine between Worms and Lauterburg at several points would have been probably more successful. The mountainous country of the Black Forest would have been avoided; the separation of Wurtemberg, Baden, and Bavaria from Prussia, would have been more complete, as so much time would not have been given for the army corps of these States to fall back towards the Prussian concentration.

Prussian Lines of Attack.

Let us now examine the lines of attack which Prussia could use if she was permitted to seize the initiative.

1st. That of Saarbruck, on Metz, or Nancy. Saarbruck is evidently an important point, being the junction of railways from Trèves, Bingen, and Mannheim, and the rear is protected by the fortresses of

Coblentz and Mayence, which thus form this portion of the German base of operations.

2nd. From Mayence, along the left bank of the Rhine, Neustadt, Weissenburg, Phalsburg, Nancy, and Saverne to Nancy, thus turning Strasburg by both lines. This portion of the base would therefore be Mayence, Mannheim, Rastadt.

3rd. Friburg, Mulhausen, Belfort, Langres, giving a line on Paris.

The first line has several advantages. The right is well protected by the neutrality of Belgium and Luxemburg, and lateral expansion for the march of columns is permitted, which can then be concentrated in the area between Thionville and Saarbruck. Trèves, the extreme right, and Saarbruck, are connected by railway.

The second line turns Strasburg and Metz, and gains a direct line to Paris, but, for a short distance, *i.e.*, between the Vosges and the Rhine, a movement along it partakes of the character of a flank march in narrow country, and the right flank might have been exposed to a French concentration.

The third line is at the south extremity of Germany, and as a subsidiary or secondary line is too much separated from the others.

We have stated that the re-entering nature of the German frontier gave Prussia a considerable strategical advantage. So long, however, as Strasburg remained in French hands this value was somewhat impaired, because it narrowed the German eastern base to Rastadt. We shall see subsequently, however, that this eastern portion of the German base was of essential value in their tactical operations east of the Vosges. The wisdom of those guiding the strategical operations of the German Army, decided to cross the Rhine in their own territory, by which means their movements were concealed to the last moment, and to advance on the strategic front Trèves, Landau, entirely on the north side of the frontier, thus securing the base of the Rhine fortresses, and directly covering Berlin.

General Situation and Concentration of French and German Armies.

It will now be necessary to describe briefly the general situation and forces of the opposing armies, and to obtain a view of the concentration on each side, for without these considerations we should be unable to enter upon the strategical position of that portion of the French Army under Marshal McMahon which was to receive the first attack of its German adversaries.

On the 12th July, 1870, the transport of French troops and *matériel* of war towards Metz commenced.

On the 15th July, war with Prussia was proclaimed, and on the 19th, the declaration of war was handed to the Prussian Government in a document which contains the *casus belli*, the plan of raising a Prussian Prince to the throne of Spain, and the refusal of Prussia to give an assurance that a "similar combination" should not be again entered into. Thus was the pretext of the candidature of the Prince of Hohenzollern, thinly veiled in official language, the subject of a declaration of war, summoning two great civilized nations to the battle-field.

We have previously remarked that in peace-time, with the exception of the Guard and the Corps at Chalons, France does not possess formed tactical units which can be placed readily on a war footing.

On paper, and according to French official documents at the commencement of 1870, the French Army consisted of—

Actual Army	400,000 men
Reserves	400,000 ,,
Guns	804
Cavalry	38,000 (horses)
Garde Nationale Mobile	550,000 men
Total	1,350,000 men.

In the early days of July the movement of troops took place, and the men on furlough were recalled.

Eight Army Corps and one Cavalry Reserve Corps were first formed, these constituting the Field Army.

A French Army Corps consists of about 26,000 or 27,000 infantry, 3,500 cavalry, and 90 guns, including 3 mitrailleuse batteries.

The following Army Corps were now formed:—

Guard Corps	commanded	by	General Bourbaki.
1st Corps	,,	,,	Marshal McMahon.
2nd ,,	,,	,,	General Frossard.
3rd ,,	,,	,,	Marshal Bazaine.
4th ,,	,,	,,	General de Ladmirault.
5th ,,	,,	,,	General de Failly.
6th ,,	,,	,,	Marshal Canrobert.
7th ,,	,,	,,	General Felix Douay.

Reserve Cavalry Corps in 3 divisions.

These corps should have given a total of

241,000 Infantry.
27,500 Cavalry.
756 Guns.

The real strength of the corps first assembled on the frontier, fell far short of these numbers, and did not exceed 200,000 men.

We must ascribe this discrepancy to the absence of men on furlough, and of the reserves which were supposed to be at hand, but which, in many cases, did not even exist. In addition to these causes, some regiments were not with their corps and could not be brought up in time.

The first troops assembled were the Guards, the Chalons Corps, the Army of Paris, that of Lyons, and the African troops, numbering about 5 corps, but by the 25th July, 7 corps were in position, though by no means ready to take the field in a condition to meet the onset of their powerful foes.

The following were the positions of the corps:—

1st Corps, McMahon at Strasburg.

2nd Corps, Frossard at St. Avold.

3rd Corps, Bazaine at Metz.
4th Corps, De Ladmirault at Thionville.
5th Corps, De Failly at Bitsche.
6th Corps, Canrobert at Chalons; but one Division was at Soissons and one at Paris.
7th Corps, Felix Douay at Belfort, in state of formation.
Guard, Bourbaki at Metz.

The magazines were placed in front line, the various corps were scattered over a wide range of country, and the Army was separated by the Vosges mountains.

Ignorant of German military institutions, confident in national superiority, concentrating first and organising afterwards, obtaining no information of the designs of the enemy, or the nature of his concentration, believing it impossible for the Germans to take the initiative, such were the military attributes of the French Army and its leaders, reflected indeed from the whole nation of which an army is only the picture, whose lights and shades are strong or weak according to the power or weakness of the nation it represents.

This phase of the campaign was soon to develop into another which was to point with disastrous clearness, that confusion of organization must inevitably lead to confusion and misfortune in the field.

On the German side there was immense numerical superiority.

The war strength of the North-German Army stood at the beginning of 1870, in actual numbers, as follow:

Standing Army (peace footing)	300,000	
Reserves	350,000	
Landwehr	370,000	
Total	1,020,000	trained soldiers.

And in addition there was:—

Ersatz Reserve	700,000	
One year's contingent (called in at once)	100,000	
Total	800,000	untrained men.

That is, there were 1,800,000 men available for military service, and of which 1,000,000 were trained soldiers.

In addition to this, Bavaria furnished 2 Army Corps, and Baden and Wurtemberg 1 Army Corps.

The *Field Army* therefore disposable, after mobilisation had been effected, numbered about,

466,000 Infantry.
58,000 Cavalry.
1,518 Guns.

A German Army Corps may be taken to consist of 26,000 or 27,000 Infantry, 1,200 Cavalry, and 84 to 90 guns.

The German Army was divided into three parts :—

I. Army under General Steinmetz, about 55,000.
II. ,, ,, Prince Frederick Charles, about 145,000.
III. ,, ,, The Crown Prince, about 140,000.

Army IV was subsequently formed.
The mobilisation of the Army commenced on the 16th July.
By the end of July,

The 1st Army was concentrated about Coblentz.
2nd ,, ,, ,, Mainz.
3rd ,, ,, ,, Mannheim.

The advanced concentration followed immediately :—

1st Army on Trèves.
2nd ,, ,, Homburg in Rhenish Bavaria.
3rd ,, in rear of Landau and Germersheim.

The Reserve, subsequently the IVth Army, was assembled at Kaiserlautern, and consisting of the IXth and XIIth Army Corps, was to support the IInd and IIIrd Armies in the first part of their march.

With the onward march of the Ist and IInd German Armies we are not concerned. Our attention must be turned exclusively to the action of the IIIrd Army, although in considering the results of that action, we shall have to refer to the direction given to the Ist and IInd Armies. July passed away in skirmishes apparently unimportant, but valuable in the intelligence gained by the enterprising German cavalry. This intelligence and that acquired in other ways by the German headquarters' staff quickly bore fruit.

The detail of the IIIrd Army was as follows :—

V. Corps commanded by General Von Kirchbach, consisting of :—

9th Infantry Division, v. Sandrart	17th Infantry Brigade, Von Bothmer. 18th ,, ,, Voigts Rhetz. 1 Rifle Battalion. 1 Regiment Cavalry.
10th Infantry Division, v. Schmidt	19th Infantry Brigade, Schönhoff. 20th ,, ,, Walther von Mensburg. 1 Regiment Cavalry.

No. 5 Regiment, Field Artillery, 84 guns.
Total, 25 Battalions, 8 Squadrons, 84 guns.

XI. Army Corps commanded by General v. Bose, consisted of :—

21st Infantry Division, v. Schachtmeyer	41st Infantry Brigade, v. Koblinski. 42nd ,, ,, v. Thile. 1 Rifle Battalion. 1 Regiment Cavalry.
22nd Infantry Division v. Gersdorff	43rd Infantry Brigade, v. Kontzki. 44th ,, ,, v. Schkopp. 1 Cavalry Regiment.

No. 11 Regiment, Field Artillery, 84 guns.
Total 25 battalions, 8 squadrons, 84 guns.

I. Bavarian Corps, commanded by Von der Tann.

1st Division v. Stephan	1st Infantry Brigade, Dietl.
	2nd ,, ,, Orff.
	3rd Rifle Battalion.
	1 Cavalry Regiment.
2nd Division v. Sappenheim	3rd Infantry Regiment, Schuhmacher.
	4th ,, ,, Straub.
	2 Rifle Battalions.
	1 Cavalry Regiment, v. Mayer.

1 Artillery Regiment, and 1 Cuirassier Brigade.
Total 25 battalions, 20 squadrons, 96 guns.

II. Bavarian Corps, commanded by General von Hartmann.

3rd Division v. Walther	5th Infantry Brigade, v. Schleich.
	6th ,, ,, v. Wissell.
	2 Rifle Battalions.
	1 Cavalry Regiment.
4th Division v. Bothmer	7th Infantry Regiment, v. Thiereck.
	8th ,, ,, Maillinger.
	3 Rifle Battalions.
	1 Cavalry Regiment.

1 Lancer Brigade.
1 Regiment Field Artillery, 96 guns.
Total 25 battalions, 20 squadrons, 96 guns.

Combined Wurtemberg-Baden Corps, commanded by General v. Werder.

Wurtemberg Division v. Obernitz	1. Infantry Brigade, v. Reitzenstein.
	2. ,, ,, v. Starkloff.
	3. ,, ,, v. Hügel.
	3 Rifle Battalions.
	Cavalry Brigade, v. Schüler.
	1 Regiment Field Artillery.

or, 15 battalions, 10 squadrons, 54 guns.

Baden Division v. Beyer	1. Infantry Brigade, du Jarry Baron v. La Roche.
	2. Infantry Brigade, v. Degenfeld.
	Combined.
	3. Infantry Brigade, Keller.
	1 Cavalry Regiment.
	Cavalry Brigade.
	1 Field Artillery Regiment.

or, 13 battalions, 12 squadrons, 54 guns.

4th Cavalry Division, commanded by Prince Albrecht of Prussia.
24 squadrons, 12 guns.

Each corps had its complement of Engineers, Artillery and Infantry Ammunition Columns, Sanitary Detachments, Reserve Hospital Depôt, Horse Depôts, Field Battery, and Provision Columns.

On the night of the 3rd August, 1870, the 3rd German Army

bivouacked between Landau and Germersheim, crossed the Lauter on the morning of the 4th, and defeated the French Division, Abel Douay, at Weissenburg, after a gallant defence, by this small outlying detachment of the French Army, against overwhelming numbers.

Field Forces.

Let us now turn to examine the forces Marshal McMahon had at his disposal, and the strategical value of the position he had resolved to defend.

The Ist Corps consisted of:—

1st Infantry Division Ducrot	1. Brigade, Wolff. 2. ,, de Postis du Houlbec.
2nd Infantry Division Abel Douay (Pellé)	1. Brigade, Montmaire. 2. ,, Pellé.
3rd Infantry Division Raoult	1. Brigade, L'Hériller. 2. ,, Lefebvre.
4th Infantry Division L'Artigue	1. Brigade, Fraboulet. 2. ,, Lacretelle.
Cavalry Division Duherme	Brigade, Septeuil. ,, Nansouty. ,, Michel.

Bonnemain's 2nd Division of the Cavalry Reserve.

Artillery Reserve, 48 guns.

Total of Ist Corps, 49 battalions, 44 squadrons, 96 guns, 24 mitrailleuses, engineers, train, &c.

The Ist Corps lay between Hagenau and Strasburg.

On the right, at Belfort, 80 miles distant, but connected by a double rail, was the VIIth Corps, General Felix Douay, in process of formation.

It consisted of—

3 Infantry Divisions. Each of 2 Brigades.
1 Cavalry Division.
15 Batteries.

Giving 38 battalions, 20 squadrons, 90 guns.

On the left, about Bitsche, and 25 miles from Hagenau, was posted the Vth Corps, commanded by General De Failly. It consisted of—

3 Infantry Divisions.

1 Cavalry Division (the 2nd Cavalry Brigade did not reach the corps.)

15 Batteries.

Giving 39 battalions, 16 squadrons, and 90 guns.

The command of McMahon was widely scattered.

On the 25th July, the 1st Division (Ducrot) was posted east of Wörth. The 2nd (Douay) at Hagenau. The 3rd and 4th (Raoul and de l'Artigue) in Strasburg.

The Cavalry Brigade, Septeuil, at Sulz. The Cavalry Brigade, Nansouty, at *Seltz*. The Cuirassier Brigade, Michel, in reserve.

The days were now approaching when the confidence of the Commanders of France in the power of the Army was to be sorely tried, and already signs were not wanting that their trust was shaken.

At the end of July, the French Head-quarter Staff became aware that the initiative no longer remained an easy task to them. The concentration of the German armies was noised abroad and the scattered disposition of the French corps was thrust unpleasantly before the minds of those directing the French operations.

McMahon was now directed to cover his communications with the Vth Corps at Bitsche, and on the 2nd August, the 2nd Infantry Division, under Abel Douay, was pushed forward to Weissenburg, to protect the march of McMahon's forces towards Bitsche. The 1st Division, Ducrot, was moved to Wörth. The remaining divisions were at Hagenau and Strasburg.

On the morning of the 3rd, Douay received information of the advance of the IIIrd German Army. On the 4th, he, with 8,000 men, received the attack of the heads of the columns forming this Army, and after a brave resistance was forced to retire.

That afternoon, McMahon, who was at Strasburg, received the news of Douay's defeat, and made the following dispositions:—

* The 3rd and 4th Divisions on Wörth.

The Cavalry Divisions on Wörth.

He telegraphed to the VIIth Corps (Felix Douay) to send whatever assistance was possible.

On the evening of the 4th, McMahon was at Hagenau.

The 5th was occupied in making preparations to accept battle in the position of Wörth.

The evening of the 5th he telegraphed to General De Failly that the Emperor had placed the Vth Corps at his (McMahon's) disposal, and he requested De Failly to unite with him at the earliest hour possible.

On the evening of the 4th August, the positions of the corps of the IIIrd German Army were as follow:—

Vth Army Corps at or near Weissenburg.
XIth ,, ,, ,,
Ist Bavarians ,, ,,
IInd ,, ,, Oberhofen and Steinselz.
Wurtemberg-Baden Corps—Lauterburg, Selz.
Cavalry Divisions { 2nd Weissenburg, in rear. 4th Weissenburg, Altenstadt.

For the 5th the following dispositions were made:—

The Vth Corps on Preuschdorf.
The XIth ,, Sulz.
The Ist Bavarian on Ingolsheim.
The IInd ,, Lembach.
The Wurtemberg-Baden Corps on Aschbach.

Marshal McMahon had now deliberately resolved to stand and bar the passages of the Vosges.

* These were on the evening of the 3rd between Reichshofen and Hagenau.

Strategical Position of Worth.

Let us examine the strategical value of Wörth in relation to the general line of the French disposition, and the advance of the German armies.

The position of Wörth covered the passes of the Vosges against an enemy advancing southwards between those mountains and the Rhine. It possessed in itself an *attractive* power, for no enemy could advance along the great roads running parallel to the Rhine, so long as the position should be held by strong force; such a movement would be essentially a flank march in presence of an enemy, and the right flank of the column of march would be, in military parlance, completely lent to the enemy.

Wörth, therefore, may be said to have covered the passes of the Vosges southward of the Lauter, and to have commanded the main *chaussées* of Alsace on the left bank of the Rhine.

Beyond this, the position may be said to cover directly the passes from an enemy crossing the Rhine from Baden. This idea may have received some development in the demonstrations German detachments made on the right bank of the Rhine.

Wörth was connected by good roads and a railroad with the right and left corps, the 7th and the 5th, and with Strasburg.

Above all, political motives probably insisted upon a stand being made for the plains of Alsace. Adherence to the sound military principle, the abandonment of territory for the purposes of concentration, was neglected, and the self-confidence of the French head-quarters prompted the Marshal to encounter what he considered the possibility but improbability of a defeat, rather than the certainty of a revolution.

When we have said the foregoing, we have exhausted the list of the strategical advantages possessed by the position of Wörth.

The first striking point is that it was only 5 miles distant from the Vosges Mountains. No second position could be found under the shelter of which a beaten Army might reform for defence. Indeed, we may go a step further, and say that for all practical purposes it was on the Vosges line itself.

The right wing of the French Army was separated from the left, the Army of Metz, by the Vosges Mountains, and an elementary principle in the defence of either a strategical or tactical line, viz., the power to concentrate on any part of it, was neglected.

In fact, the position of Wörth was disunited from the other fraction of the French Army, and the acceptance of a battle there could only be justified as belonging to an independent campaign. In this case, superiority of numbers and certainty of tactical victory might render it permissible to deliver battle in this position.

In the actual disposition of the French corps, the value of Wörth and the defence of the Vosges seems to have been completely misapprehended. And this seems the more extraordinary as the text-book of military geography, used in the Military Colleges of France, is clear enough in teaching the difficulty of defending the line of the Vosges. It needs no profound acquaintance with strategy to see how thoroughly the line of

the Vosges is turned by an advance from the strong fortresses of Mayence and Coblentz. Is it possible the French Commanders could have supposed the Germans would have neglected the advantages given to them by their natural base, and a line which directly covered Berlin?

This consideration brings us to the question of De Failly's possible action. De Failly had a corps of 30,000 men with which he was to keep up communication with the right wing and the right portion of the left wing of the French Army. He knew of the Prussian concentration at Kaiserlautern, and Homburg, but he could not anticipate that the weight of the IInd Army could be directed against Saarbruck; an advance on the Zweibrücken-Bitsche road would menace his communications with the main French Army. Consequently an advance of the Germans on the western side of the Vosges would isolate him from the main body of the French Army. These considerations probably led to the order sent to him, through McMahon, that his corps was placed at the Marshal's disposal, in the hope that tactical victory might compensate for faulty strategy.

We shall, further on, allude to De Failly's scattered disposition, and his non-support of McMahon.

Apart from the closeness of Wörth to the Vosges, it was too far from Strasburg to rely upon that stronghold as a support in case of retreat, such a line would have been endangered by the Prussian advance, while it was only allied to the other portions of the French Army by a weak and extended connection.

Retreat on Bitsche was, without considering the difficulty of the line, only bringing the retreating force towards fresh danger (assuming that the absolute advance of the IInd German Army on Saarbruck was unknown), so that the only course open in the case of defeat would be to retire by the passes of Lichtenberg and Petite Pierre, assisted by the railway from Hagenau, which in its circuitous course to Saverne and Phalsburg might be endangered by the active operations of the Prussian cavalry.

Further, the line of battle which must be formed on the Wörth position has its direction strategically advantageous for its worst line of retreat, that by Bitsche, while for retreat towards Hagenau or Saverne the line of battle must be formed parallel to the line of communication.

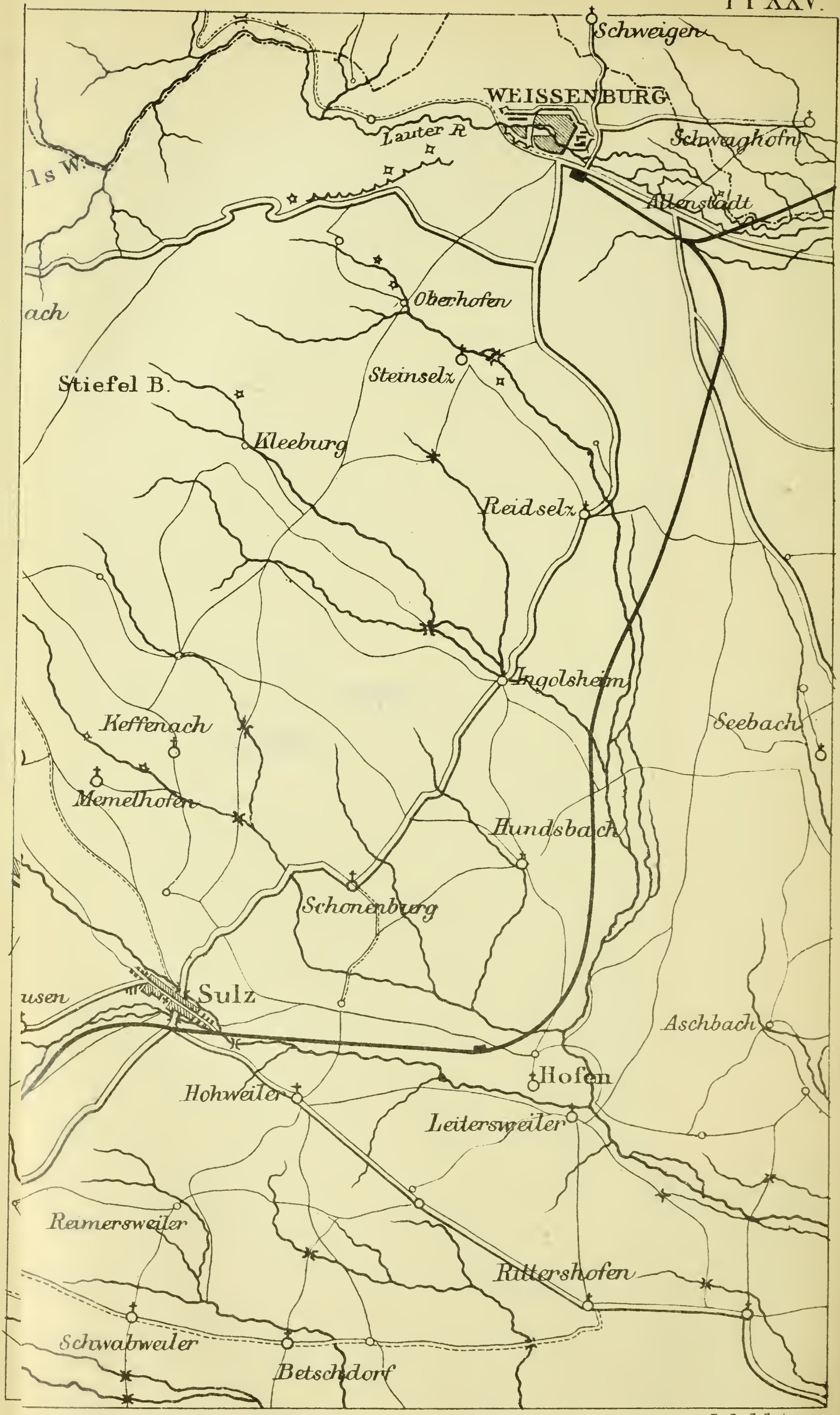
Description of Neighbourhood and Battle Field.

The Vosges Mountains, between Pérmasens on the W. and Weissenburg on the E., assume the character of a long promontory jutting out between two bays. In the northernmost of these bays, rises the River Lauter, and in the most southerly, the little River Sauer. The long spur or promontory running in S.E. direction turns, near Weissenburg, nearly due S., parallel to the Vosges or the Rhine, forcing the Sauer into a like parallel course until near Wörth it releases it, and allows it to find its way towards the great river.

It is this high ground parallel to the Vosges which is called the Hoch-Wald, and whose southern spurs, of gentle slope, still clinging to


Scale 1:100,000
0
1/4
1/2
3/4
1 German Mile
English Miles.
0
1
2
3
4
Schweigen
WEISSENBURG
Schwaghofen
Lauter R.
Altenstadt
Dirbels W.
Wingen
Sauer R.
Jungen W.
Climbach
Oberhofen
Lembach
Stiefel B.
Steinselz
Kleeburg
Reidselz
Mattstall
Hoch Wald
Ingolsheim
Langensulzbach
Keffenach
Seebach
Neuweiler
Memelhofen
Hundsbach
Lampertsloch
Niederbronn
Mitschdorf
Görsdorf
Preuschdorf
Grosse W.
Schonenburg
Froschweiler
Selz R.
Wörth
Sulz
Kützenhausen
Aschbach
Reichshofen
Elsashausen
Tiefenbach
Hölschloch
Hofen
Hohweiler
Nieder W
Spachbach
Leitersweiler
Neider W.
Oberdorf
Bruch M.
Gunstett
Eberbach
Schirlenhof
Reimersweiler
Landsberg
Gundershofen
Surburg
Rittershofen
Engelshof
Morsbronn
Schwabweiler
Betschdorf
Forstheim
J. Jobbins

Pl XXV.



J. Jobbins

the course of the Sauer, form the position from which the Prussian IIIrd Army was to advance in attack against McMahon's forces holding the ground on the opposite bank of the stream.

The Vosges promontory or spur, of which we spoke above, declines into hilly ground until it makes the turn near Weissenburg, where it assumes a height of 800 feet, forming a high wood-covered range of hills some 6 miles long, and a prominent object in the landscape for many miles.

From this Hoch-Wald, trend out many spurs sloping very gently S.E. towards the low wooded country between them and the Rhine. Many streamlets, rising in the Hoch-Wald, flow down between these spurs towards the lower plain country, and their S.W. banks offer favourable positions for defensive actions; the left resting on the Hoch-Wald, and the right observing the low ground to which the spurs all gradually sink.

The country therefore S.E. of the Hoch-Wald, between Weissenburg and Wörth, may be described as one strongly undulated. The ground is much cultivated, here and there largely wooded, dotted by numerous villages, sometimes clustering very near to each other, a land traversed by numerous good roads, and remarkably easy for great military combinations.

The Battle Field.

The battle field of Wörth may be described as formed by two parallel lines of hills, whose altitude is about 300 feet above the River Sauer, which flows between them in a meadow valley, of a breadth varying from 300 to 1,200 yards. The eastern line of hills somewhat commands, at points, the western range.

The eastern line of hills, forming the Prussian position, is about $2\frac{1}{2}$ miles in extent, *i.e.*, from the village of Gorsdorf to Gunstett (see Plate xxv). We have called this the Prussian "position," because the extension of the line along the W. slopes of the Hoch-Wald and towards Langensulzbach can hardly be called a position in the ordinary military meaning of the term.

The opposing line of hill, upon which the French Marshal ranged his forces, was nearly twice as long as what we have termed above, the Prussian position, so that the French line, about $4\frac{1}{4}$ miles long, may be said to have outflanked that line of hill on the Prussian side over which they made their main attack, by about a quarter of its extent on either side.

The French position of Wörth was of sufficient strength to be a tactical temptation to Marshal McMahon to endeavour, in this chosen place, to stay the onward march of the columns of the IIIrd German Army.

Distant not five miles (as the crow flies) from Niederbrunn, the little town at the E. *débouché* of the pass of Bitsche, traversed along its extent by fair country roads, and transversely perpendicular to the general front by a good *chaussée*, its left flank resting on large woods and its right domineering the low country in front, and trending back to the

road which might be a line of retreat, and with open ground immediately in front, which could be swept by fire from spurs which ran forward like natural bastions ; we cannot wonder that the Marshal felt unwilling to abandon such advantages without a struggle, and rather determined, confident in the valour of his troops and the strength of his position, to stake his fortunes upon one throw of the die.

The high ground or line of hills upon which the French troops were ranged, is formed by the S.E. slopes and spurs of the Vosges. It can scarcely be called a plateau, except in a very wide sense, for it is broken up into numerous small plateaus and undulations. Two of these are tolerably marked, however, by the positions of the villages of Neuweiler and Froschweiler. The right half of the position is divided very distinctly into two parallel positions by the valley through which runs the little streamlet, the Eber.

The main line of the hills forming the French position may be taken as parallel to the *chaussée* Niederbrunn, Reichshofen, Hagenau, and about $2\frac{3}{4}$ miles in front, while immediately in advance and commanded by the line of hill runs the Wörth-Hagenau road, an excellent line of communication 24 feet wide, and raised above the marshy meadow-land through which it runs.

The line of the French position is also shewn by the stream which flows from the lateral valley of Langensulzbach, joining the Sauer at Wörth, which thence flows with a breadth of about 30 feet and ordinary depth of 2 feet or 3 feet,* meandering and winding southwards until it enters the low country at the outlet of the valley where it turns in a S.E. direction to flow through the fertile plains of Alsace towards the Rhine.

Wörth itself is a small town completely commanded by the hills on both sides. Through it passes E. and W. the high road Reichshofen-Sulz, at which latter place this road joins the main Weissenburg-Hagenau *chaussée.* At right angles to this Reichshofen-Sulz road, is that of Lembach, Langensulzbach, Wörth, Hagenau, and from this at about 1,500 yards N. of Wörth, branches off another road which follows the course of the Sauer for some distance, crosses it, and attains Lembach viâ Mattstall. From Wörth also, or rather from the Reichshofen-Sulz road, and 100 yards beyond the last houses of the town, on the right passes the road to Spachbach, and on the left or N. the road to Görsdorf.

The left of the French position lay on the hills which trend back from the little village of Langensulzbach. Here a small stream runs through a valley some 400 yards wide, open, and with its N.E. slopes, in many parts very open to those posted on the French side. This line of hill on the French left was not, at its crest, so high as the front line, fairly indented, not wooded on the slope, but sprinkled with trees and copses. About halfway between Langensulzbach and Wörth a deep ravine runs back, widening out, forming small lateral ravines, and whose sides are thickly wooded.

The summit of this part of the French position is at Neuweiler, a

* It was from 5 to 6 feet deep on the 6th August, 1870.

straggling village situated on the road from Froschweiler, on the slopes and spurs of the plateau-like ground upon which was posted the French left. This ground sinks gradually down to a stream which flows towards Reichshofen through a dense forest which covers the left rear of the French position, and extends in broken and accidented ground to the foot of the mountains.

Returning to the French line, the straggling village of Froschweiler, partly situated on the level and partly on the slopes towards Wörth, commands the long ravine in front, which widens out into the low meadow-land through which the Sauer flows. The left of this ravine, looking from the French position forms a long spur, indented by smaller ravines, and covered by a wood which gradually stretches from the crest near Froschweiler down to the point where the Langensulzbach valley trends back in a N.W. direction. The slopes of this part of the position are covered with vineyard and cultivation, and their steepness varies from 5° to 15°.

The road from Froschweiler to Wörth leads over a long spur which runs out towards the town. A similar spur, broken in folds, slopes forward in the same direction, and between these lies a large ravine, with a gentle declivity of 4° or 5°, which is commanded by the ground on the line Froschweiler-Elsashausen. Upon the knoll or crest of this last spur stands the key of the French position, the village or hamlet of Elsashausen.

This Elsashausen spur breaks forward to the right front in gentle folds, down to the road Wörth-Hagenau, with slopes from 5° to 8°. A long wood, the Niederwald, in some parts thick, in others with little underwood, and trees of no great size stretches in an irregular indented line from about 400 yards S. of Elsashausen, running below the crest of the hill, and at last striking down in a four-sided patch, almost separated at one angle from the remainder, the lower side of it skirting the road Wörth-Hagenau for some 350 yards. S. of the Elsashausen spur is a ravine trending far back into the French position, and along whose W. and S. slopes stretches the wood which we have mentioned above. The ground now somewhat declines in steepness, consisting of undulating spurs of 5° or 6°, with patches of wood, and somewhat thrown back towards Eberbach. The large wood, the Niederwald, extends back to the line of the Eber stream. Still looking towards the right we see the village of Morsbronn at the foot and on the slope of the undulating hills, which near the village, at about 1,000 yards from the S. corner of the large wood, trend gently back in slopes of 3° or 4° towards the great Hagenau Wald, the little village of Hegeney lying at the foot of the E. slopes. The second line of hill, or the W. slopes of the Eber, sweep gradually back in a S.W. direction. The village of Forstheim stands on the crest of this line of hill, whose open and undulating slopes have a steepness of about 8°. Forstheim is to the right rear of Morsbronn and about one mile distant.

The Morsbronn Hills command the open country in front, and to the right front very completely. Slight undulations take but little away from the glacis-like character of the country lying below, and over

which it seems, at first sight, madness to advance any considerable body of troops under the fire of an enemy posted on the Morsbronn Hills.

The Eberbach Valley slopes gradually down from N. to S., from a point about 1 m. W. of Elsashausen and widens out gradually from near the village of Eberbach situated on the slope. The rear of the second or Eber position is formed by undulating hills, whose spurs gradually decline towards Reichshofen, and the Reichshofen-Hagenau road. The largest plateau is that of Froschweiler, in rear of the left centre of the French position and, with that of Neuweiler, form good positions, slightly interspersed by wood, but generally open, undulating and favourable for the manœuvres of all arms. Between Froschweiler and Neuweiler, there is a fall in the ground formed by a sort of saddle made by the head of the ravine, which stretches up from the valley of the Sauer, and somewhat divides the French front line.

Several roads and tracks, as shown on the map, lead up from the Sauer Valley over the line of the French position.

The villages forming part of the French position are well built, of stone and tile, and the enclosure walls round render them well adapted for defence.

Let us now examine the ground which the Germans used in the development of their attack.

On the right opposite Langensulzbach the hilly ground on the German side is in some parts open, and in others covered with wood, the slopes, however, towards the French position, are open, and indeed, we may here observe, that with the exception of a small portion of the line under the W. slopes of the Hochwald, and where there were vineyards, the slopes down which the Germans had to pass, are as open as any of our English downs, and are well commanded and swept by artillery placed on the French side. On the right, however, we find the greatest amount of wood, and this was well utilised in the German advance.

The little village of Görsdorf, situated some 150 feet below the crest of the S. spur of the Hochwald, which forms the range of hills known as the Prussian position, marks the right of the main attack opposite Wörth. The ground slopes in undulating folds gently down to the valley of the Sauer, which here widens to about 1,000 or 1,200 yards. The slopes are about 7° to 5° gradually lessening till they sink into the meadow land below. The sides of the hill are quite open, and under cultivation.

The Hochwald, which stands boldly up on the right of the German line, is well wooded, to within 300 yards of the line, where it loses its steep and rugged character, gradually blending into the softer outline of the lower hills.

The summits of the hills at this point decline gently towards the Wörth-Preuschdorf road which here crosses them, rising again slightly to the village and wood of Tiefenbach.

In the valley in front of this portion of the line is the mill near Wörth, placed at a bend of the stream.

The ground now sweeps forward in a spur, which declines with a

slope of 7° or 8° to the village of Spachbach, and trending back forms with the line of hill on the S., a long ravine, at whose *débouché* the village is situated. Again running forward, the hills close towards the French position opposite the four-sided patch of the Niederwald, which borders the Wörth-Hagenau road at this point. The W. slopes are covered with vineyards, and on the S. slope of this long undulating spur lying back in a N.E. direction, is the village of Gunstett. From this point the hills sink gradually down to the low plain country, thrown backwards in easy rounded slopes, which overlook the lower ground.

The position is traversed by good but irregularly dissected roads, such as those between Görsdorf, Tiefenbach, Oberdorf. The undulations of the line of hills eastwards and towards the high ground of Preuschdorf, well conceal the movements of troops from an enemy on the French side. A road runs from Gunstett to the Bruck Mill, over the French position. Bridges over the Sauer only existed at this point, at Spachbach and at Wörth. One thing very noticeable is the great extent of open ground (before alluded to) on the left of the German position, S.E. of Gunstett and towards Düssenbach, and again behind these villages right away to the Wald, and the high ground of Preuschdorf.

Looking from the French position, with the aid of a map, we seem at once to obtain a clear view of the Prussian line of attack. The villages stand out, clustering the houses and cottages, which in England would take away by their scattered positions from the marked character of the groups. The Hochwald towers on the left, the hills which form its spurs sink gently down towards the low-lying Alsatian plains and forests, and undulation after undulation, varied by wood and open cultivation, greet our eyes as we look in the direction of Weissenburg.

In this as in other scenes of the war of 1870–71, the country seems to unfold itself to us like a map; we can easily recognise its military features and trace the history of the feats of arms performed on it, and we cannot help the reflection coming, that strategy and tactics are alike easier than in our own intersected land.

Such, imperfectly described, is the battle field of Wörth. All that remains of the shock of war are the marks of cannon shot on the houses, the white patches where loopholes existed, new houses in place of those burnt down, and above all, the white crosses which remind us in looking over the quiet beauty of the landscape, that here Frenchmen and Germans fought and died the death of heroes, for the honour of France, or the glory of the Fatherland.

Disposition of Troops.

On the 5th August, McMahon disposed his troops as follows:—

The 1st Division (Ducrot), right on Froschweiler, left on the Grosse Wald,* in rear of Neuweiler.

* The French official despatch says "in the direction of Reichshofen, resting on a wood covering this village." If this was the case, the left wing of the Marshal

The 3rd Division (Raoult), forming the centre, on the line Froschweiler-Elsashausen.

The 4th Division (L'Artigue), along the line of hills towards Morsbronn.

The 1st Infantry Division of the VIIth Corps (Conseil-Dumesnil), arrived the evening of the 5th from Hagenau, where it had disembarked from the railway. Its artillery was on the railway, Colmar-Hagenau. The division was posted in rear of the 4th Division.

The 2nd Division (Abel Douay's, now Pellé's), arrived by rail in the evening from Hagenau. It was posted in reserve in rear of the 4th Division.

The Reserve Cavalry Division, Bonnemain, was posted in rear of the centre, on the undulating ground halfway between Elsashausen and Reichshofen.

The Cavalry Brigade, Septeuil, was posted in rear of the centre and towards Reichshofen.

The Cavalry Brigade, Michel, was ranged on the same line as the Cavalry Division Bonnemain, but still further to the right, on the ground sloping towards the Eber, and in rear of the 4th Division. The Cavalry Brigade Nansouty was detached. To enable the offensive to be taken easily, the bridges over the little River Sauer were not broken.* Engineer officers were sent to explore the lines of retreat, and detailed instructions were issued for the retreat.

Later in the evening a telegram was sent to De Failly, directing him to unite with the Ist Corps as soon as possible.

We have no absolute evidence to show what were the exact lines of retreat the Marshal determined upon, nor do we know whether he was kept informed by telegraph by De Failly, or the head-quarters, as to the advance of the Second German Army W. of the Vosges. Further, the question as to whether he had been placed in possession of the change which had taken place in the plans of the head-quarters from offensive to defensive. He would probably know that Frossard was at Saarbruck with the IInd Corps, and that the Prussians had concentrated at Kaiserlautern and Homburg, so that an interval, if De Failly was drawn towards him, must exist between Frossard and Bitsche, through which it might be possible for a German column to advance. In any case Bitsche leading too near to the enemy's advance would not seem a favourable line of retreat. But how are we to reconcile this, supported as it is by the disposition of the Marshal's left wing, with the fact that a French detachment of two companies was directed to hold Jägerthal, a village three miles from Froschweiler, at the mouth of a defile leading eventually to Bitsche? Again, the officer who took a despatch from the Marshal on the 6th August to De Failly, chose, not the pass of Niederbronn, but a secondary valley leading from Reichshofen towards Bitsche, because it was feared the Prussian

would nearly face one line of retreat, that by Bitsche. From information obtained subsequently, it appears that the *first* disposition of the French left was made with the idea of an attack from a northerly direction.

* Orders were at first issued for their destruction.

cavalry were in the Niederbronn Valley. As a matter of fact the Marshal did use both his Jägerthal-Bitsche and the Niederbronn-Bitsche lines of retreat.

Besides the circuitous lines by Hagenau, there were several good country roads open as lines of retreat.

1.* Niederbronn-Oberbronn-Rothbach-Ingweiler, by the pass of La Petite Pierre to Saar-Union, where roads from Sarreguemines, Tuttelange, Bitsche, Phalzburg, and Hagenau unite.

2. By Gundershofen-Rothbach, the pass of Lichtenberg-Wimmenau, and eventually to Saar-Union or an intermediate line, Gundershofen-Bärenthal-Mullerhausen-Lemberg.

3. The Saverne road by the pass of Phalsburg.

Between Ingweiler-Wimmenau there was a country road, Ingweiler-Spachbach-Eckarstweiler.

There are also numerous tracks suitable for the passage of infantry and cavalry.

On the evening of the 5th August the IIIrd German Army stood as follows :

Vth Army Corps at Preuschdorf.
XIth ,, ,, ,, Sulz, and in advance.
Ist Bavarian ,, ,, Ingolsheim.
IInd ,, ,, ,, Lembach.
Wurtemberg-Baden at Aschbach.
Cavalry Division at Schönenburg.

The general line being on the little river Selz ;
Head-quarters at Sulz.

The dispositions for the following day, the 6th, were :—

Vth Corps on the line of the Sauer.
XIth ,, on Holschloch.
Ist Bavarians on Preuschdorf.
IInd ,, to line of Sauer on extreme right.
Wurtemberg-Baden from Aschbach to Hohweiler and Reimersweiler.

Cavalry division and head-quarters to remain at Schönenburg and Sultz respectively. That evening, the 5th, the outposts were established on the line of hills E. of the Sauer.

Let us now return to view the disposition made by Marshal McMahon for the defence of the position of Wörth, and the relation of the numbers of men to the extent of ground.

On the left the 1st Division (Ducrot), 13 battalions occupied a line 2,400 yards in extent. Allowing 650 men† per battalion, this would give 8,450 infantry for 2,400 yards, and they were probably, therefore, in two lines. This division gave two companies to Neuweiler.

The 3rd Division (Raoult), about the same strength, occupied the long spur opposite Görsdorf, its right resting towards Elsashausen.

* This is a high road.

† It is difficult to find the exact strength of the French battalions. The above is only an average.

The length of this line was about 2,000 yards, and the line was broken by the ravine on the N. of the Froschweiler-Wörth road.

This division furnished the garrison of Wörth.

The 4th Division (L'Artigue) occupied the remainder of the line as far as the hills behind Morsbronn. This village was not occupied defensively at first. The 4th division, therefore, about 8,450 strong, occupied a line nearly 4,000 yards in extent, including in its line a great wood, which by its nearness to the Prussian line of hills formed a weak point. Elsashausen was garrisoned by the 4th Division. This line, however, was supported by Conseil-Dumesnil's division, the 1st of the VIIth corps.

The woods on the left were probably occupied in some way by the 1st Division, but the general line ran from some 700 or 800 yards S.W. of Neuweiler, in a S.E. direction to the spur N. of the Froschweiler-Wörth road, and then due S. towards Morsbronn.

The total length of the line at first occupied would be about 8,400 yards, and in this line were placed about 33,800 infantry (including Conseil-Dumesnil's division, Pellé's division being in reserve), 102 guns, 30 mitrailleuses, and 5,400 cavalry.

The total number of troops at the disposal of Marshal McMahon would be about:—

40,000 infantry.*
5,400 cavalry.
132 guns and mitrailleuses.

The Artillery were mostly posted on the Landsberg (Albrechtshauschof) and at Elsashausen, in the front line.

The Tactical course of the Action.

First Phase.

The dispositions ordered by the Crown Prince for the 6th August, commenced at dawn on that day. At daybreak skirmishing began along the line of the Sauer, between the outposts of the opposing armies, but on neither side was action expected.

The advanced guard of the 4th Division of the IInd Bavarian Corps (Bothmer) engaged the outposts and advanced troops of the 1st French Division (Ducrot), posted near Langensulzbach. This was about 7 A.M.

On the centre, Major-General Walther v. Montbary, commanding the 28th Brigade, 18th Infantry Division, the advanced portion of the Vth Corps, sent a battalion down the slopes of the hill to attack Wörth, covered by the fire of the batteries of the advanced guard. It was repulsed with heavy loss.

On the left the advanced guard of the XIth Corps had reached Holschloch.

* This is probably somewhat under the mark, but it is allowing 650 men per battalion. The French war strength is about 940 strong. The losses of the 2nd Division (Abel Douay) at Weissenburg have been deducted.

The attack, therefore, was in a sort of wide echelon of corps from the right which was hotly engaged, the guns of the IInd Bavarian Corps having reached the hills E. of the Langensulzbach Valley, and replying to the fire of some of Ducrot's guns, advanced forward.

Gunstett was occupied by a detachment of the Vth Corps.

The Commander of the Vth Corps, mindful of the orders of the day, directed the attack to be broken off. This order, however, could not be carried out, for by 8 o'clock the first detachment of the XIth Corps, which was marching towards the direction of the firing, the 87th Regiment, debouched from the woods in rear of Gunstett, and reinforced that village, and the left of the line was engaged.

Second Phase.

At 9 A.M., therefore, the situation was as follows:—The fringe of the various German Corps was just becoming entangled with the French line, for the IInd Bavarians, in greatly superior force, were gaining ground on the right. In the centre, the advanced guard of the Vth Corps was engaged, and on the left the advanced guard of the XIth Corps were deploying, four batteries took position, and unlimbered on the long hill N.W. of Gunstett.

The remainder of the XIth Corps and the Wurtemberg-Baden Division were still from three to five miles in rear of the left.

The Ist Bavarians was marching towards the centre of the line, or upon Preuschdorf.

On the right wing, the IInd Bavarians gradually gained ground, mastering the terrain by degrees, and pushing back parts of the 1st Division of the French, up to 10·30 A.M., when the order was received from head-quarters to suspend the fighting, and in consequence of this, General Bothmer withdrew his troops from the Langensulzbach position.

On the centre, the Vth Corps deployed in two lines by divisions; the 10th Division in first line, the 9th Division in second line, and the batteries of the advanced guard were reinforced by those of the main body or corps artillery, the whole being posted on the high ground S. of Görsdorf, and opposite Froschweiler. The effect of the superior fire of 84 guns soon becoming visible, the order was given to assault Wörth, and endeavour to gain the spurs beyond. While the centre was thus developing in strength, the left was gradually acquiring importance in the line of battle. In consequence of the marching of French troops in the direction of Gunstett, the advanced guard of the XIth Corps had been quickly deployed, and the artillery massed on the hills N.W. of Gunstett. The main body of the corps was advancing to reinforce the line. The Brüchmuhle was occupied, and the 22nd Division of the XIth Prussian Corps was advancing S. of Gunstett, in the direction of the Landsberg.

Let us now turn to the French dispositions.

On the left a change had taken place. The 1st Division (Ducrot) had changed position to its right, and was now more in a line prolonged from Elsashausen-Froschweiler towards Neuweiler.

The centre (Raoult) was occupied in replying to the artillery of the Vth Prussian Corps, and in repulsing the efforts made to take Wörth, and after that point was captured at 12.30 P.M., in endeavouring to prevent the Prussians from establishing themselves on the spurs of the hills on the French side of the Sauer.

Several batteries were posted at Elsashausen, and firing upon the advancing left wing of the Prussians, as well as endeavouring to reply to the artillery of the Vth Prussian Corps, part of which was established on the hills S. of Tiefenbach.

On the French right, L'Artigue had concentrated his divisional artillery on the Landsberg against those of the XIth Prussian Corps. At 10.30 A.M. the right wing of the French made a strong offensive movement against the Prussian left, a brigade (Lacretelle) of the 4th Division was advanced by Morsbronn against Gunstett, but was repulsed and followed across the open as far as the Wörth-Hagenau road, which, raised above the meadow land, gave them cover. At 11.30 a second attack was made upon Gunstett by Conseil-Dumesnil's division, which established itself in the outskirts of the village, but were shortly after driven back by the 21st Infantry Division (Schachtmeyer) of the XIth Corps.

Up to 12.45 A.M. the battle had languished on the extreme right of the Germans, but at this hour the order reached the IInd Bavarians that the fight was to be continued, and gradually the advanced portion of the Ist Bavarians approached the battle-line Langensulzbach-Görsdorf, passing by the latter village.

In the centre, Wörth had been taken by the 10th Division of the Vth Corps, the endeavours made by the French to retake it were repulsed, and efforts were made to gain a footing on the slopes of the hills beyond.

On the left, at 12.45, the corps artillery had arrived and deployed. The 22nd Division, advancing against the French right, pushed it back from the Morsbronn Hills; the Wurtemberg cavalry brigade also menacing the enemy's extreme right. The 21st Division, XIth Corps, was now under cover of a heavy artillery fire, advanced across the Sauer, and gained the Elsashausen Niederwald, opposite Spachbach. At about 1 P.M. therefore, the French line was being gradually thrust back and compressed on its flanks, on the left, a raging conflict was maintained in the woods, on the centre, the German line was now creeping up towards Froschweiler and Elsashausen, despite the desperate efforts made to dislodge them, while on the right, the 4th Division L'Artigue was thrown back on the Eberbach by the increasing pressure of the XIth German Corps.

Third Phase.

The decisive advance of the whole German line commenced about two o'clock.

On the right, the Ist Bavarian filled the gap between the extreme right, the IInd Bavarian, and the centre, the Vth Corps. Advancing across the meadow land, they threw themselves into the woods which stretch from the long spur N. of Froschweiler, down to the lateral Langensulzbach Valley, and won their way step by step up the vine-

yards and slopes of the French position. On the extreme right, the IInd Bavarians were gaining ground, but strongly and heavily checked every now and then by the brave efforts of the Ist Division, which was now opposed to two whole corps.

On the centre, the Vth Corps had succeeded in establishing itself on the E. slopes of the French position, advancing by a "continuous forward rallying" of small fractions. Detachments had joined with the 21st Division of the XIth Corps, and were mastering the Elsashausen Niederwald by degrees. On the left, the 21st Division was working up through the wood in the direction of Elsashausen. The Wurtemberg-Baden Corps was now arriving to the support of the XIth Corps. One brigade had arrived at Gunstett about one o'clock, and was directed on the Landsberg-Eberbach line. The divisional cavalry filled the gap between the Wurtemberg Corps and the XIth Corps. The guns of the German left wing had established themselves on the hills E. of Eberbach, and the Wurtemberg cavalry brigade was moving up behind the extreme left. The cavalry division had advanced upon the ground between Gorsdorf and Tiefenbach. At two o'clock Elsashausen was taken.

Fourth Phase.

The French, therefore, were now being turned on both flanks. On their *left*, the 1st Division (Ducrot) was endeavouring, from the plateau of Neuweiler, to make head against the pressure exerted by the Ist and IInd Bavarians. In the *centre*, Froschweiler still remained to them, but its safety was now endangered by the capture of Elsashausen by the Germans. Accordingly, it was now that Marshal McMahon directed all his efforts against the enemy's centre. Down the gentle slope, charged Michel's Cuirassiers against the XIth Corps, and the Wurtemberg soldiers. But the terrible sacrifice was fruitless. The Cuirassiers were annihilated. The infantry now tried to regain Elsashausen, but in vain. Part of the French right wing (of L'Artigue and Conseil-Dumesnil's division) had been somewhat separated from the centre by the attacks of the XIth Corps, and the possession of Elsashausen would have re-established the line of battle.

Froschweiler now became the centre of battle, and every effort was made by the French Marshal to keep it. The reserves were brought up and directed against Elsashausen, the cavalry charged the Prussian infantry with unequalled and desperate gallantry. But the day was lost to the Marshal.

The Prussian and Wurtemberg Corps were closing round. At 3.30 P.M. Froschweiler was taken, and the battle won by the Germans.

The French infantry retreated through the woods and over the hills, some towards Reichshofen, some through the forest to Niederbronn, others by Jägerthal; the artillery by the roads. Little help was obtained from General de Failly. Part of the division, Guyot de Despart, arrived at Reichshofen by rail,* and somewhat protected the

* The local people say *none* of De Failly's troops passed Niederbronn, and that when the French retreat began, they simply faced about. Perhaps there were *other* portions of De Failly's troops.

retreat by Niederbronn. At the entrance to the pass the advance of the German cavalry was checked. The main portion, however, of the French troops retreated towards Saverne.

The French lost 4,000 men and 8,000 prisoners. The Germans lost 8,000 men, including 400 Officers.

Comments.

The position of Wörth is tactically very strong, but its strength depends upon the occupation of the whole line, from Langensulzbach to Morsbronn and back to Forstheim. Elsashausen, from its commanding situation near the centre of the line, is called the key of the position, and it is so, no doubt, but at the same time we should be inclined to attach equal importance to the wood near, because from that wood the rear of the centre can be penetrated and Elsashausen and Froschweiler can be turned. This wood, called the Elsashausen Niederwald, is evidently the weak point, as at its lowest end it trends out towards the German side, and afforded them the quickest point of passage across the meadow-valley, which was swept by fire. This was therefore the point at which the Commander of the XIth Corps aimed the brigade which he sent across the Sauer. We are told that the position was entrenched, but beyond shelter-trenches we are not told what works were constructed. Few positions offered more favourable opportunities. A field-work on the Neuweiler plateau, intermediate between that village and Froschweiler, and connected by shelter-trenches, would form an excellent second line for the left, shelter-trenches round the crest of the line of hill as a front line, and the right continued beyond Morsbronn, by a fieldwork on the spur to the S.W. of that village.

The right was very strong, because it commanded the low country, which formed a kind of glacis in front of it. Entrenchments here would have assisted to prevent the turning movement made by the Germans.

The left was a point favourable for attack on account of its wooded character. Marshal McMahon expected attack on this flank, it is said. If this be the case, it is difficult to understand why the wood and heights bordering the Langensulzbach Valley were not occupied in force at the commencement of the action. When however he saw the advance of the IInd Bavarians from the direction of Marstall towards Langensulzbach, he considered that it was only a demonstration (so it is reported), and that they could not have marched so widely in any strength. A glance at the map, however, shows that there is an excellent road from Weissenburg to Lembach, which affords good scope for the favourite manœuvring of the German Commanders. The position would have been greatly strengthened by the felling of the lower part of the Elsashausen Niederwald, where it abuts upon the Wörth-Hagenau road, and by the formation of a log-parapet and abatis, such as were used in the American war.

Having said this with regard to the actual position, let us examine the formation the Marshal adopted. It appears *too deep* for the ground, and that so far from the line taken up being too long, it was

not long enough. We are told that "masses of troops" appeared every now and then on the hills, and the column-formation seems to have been adopted up to a line which brought them within the enemy's zone of fire.

In the conduct of the early part of the battle, we are at a loss to perceive the advantage of the successive French attacks upon Gunstett. That village is on the S. slope of the hills, and the possession of it could have no influence on the advance of the Germans on the line of hills to the N. Had the French right been extended and maintained, the possession of Gunstett would have narrowed the German frontal advance, and probably the attack by the German right would have been more developed. But in the actual circumstances of the combat, Gunstett would have become an isolated post, and its garrison would have fallen an easy prey to the Germans when their attack on the French right had strengthened itself. Further, in attacking Gunstett across the valley, the advantages of the defensive were abandoned without any prospect of adequate result. The position of Wörth is essentially a *defensive* one, the hills on the E. side are so much of an equality in height and steepness to those on the W. side (the French position), that the value of offensive returns from the defensive line is impaired, for in the first movement down the slopes of the French position we are uncovered to the enemy's artillery and musketry, and in endeavouring to mount the opposite slopes we are precisely at the same disadvantage the enemy experienced in his attack upon our defensive position. Nor could the possession of Gunstett by a few battalions prevent the wide turning movement the Germans made upon the French right. The proper defence of that right was the arc sweeping southwards from Morsbronn to Forstheim.

The "change of position to the right" of the French left wing was, it is stated, executed with marvellous precision. But it came too late; the IInd Bavarians had already gained a footing on the wooded slopes S. of Langensulzbach, and the faultless execution of the manœuvre was of little avail against the ever-sweeping-on fractions of the Bavarian corps.

Condemning, then, the offensive attacks upon Gunstett, we turn to the consideration of the last offensive attacks of the French Marshal, made with the object of regaining Wörth and Elsashausen. With regard to the former, it admits of argument whether the possession of it in the last phases of the action was of sufficient value to induce such a sacrifice of life. As a retarding point, it was, in the first instance, no doubt valuable, but with the increasing pressure on both flanks, it appears not to be quite certain that the efforts to retake it would be followed by any important military result. On the other hand, the attacks on Elsashausen from Froschweiler, and the effort to break the German centre were strictly justifiable, as a general principle. The employment of the cavalry, however, was a melancholy proof of its valuelessness against unshaken infantry armed with the breech-loader.

McMahon is said to have divided his artillery too much. We may perhaps be permitted the remark that in the early phases of the action this was almost a necessity, and the ground of the French position

certainly admits of the "dispersion of guns and the concentration of fire." The first part of this precept was carried out, but not the latter, with sufficient precision. In the latter phases of the action, probably the guns might have been massed with greater advantage, both to keep down the fire of the artillery of the Vth Corps, and to hinder the advance of that corps, and the right wing of the XIth Corps.

The reserves were not used sufficiently early in the action.

We may then consider that if the position of Wörth was to be held, the line should have been more extended than it was, and a greater development of fire should have been obtained. But the task imposed upon the French soldiers was too great. Apart from the fact that their genius lies not so much in defensive as in offensive warfare, the position on its left and right centre, admitted of too many possible danger-points, the forces were too unequal to make head against the continually reinforced line of the Germans, whose numbers rendered ultimate victory almost a certainty.

All that criticism can say is, that a better disposition of his troops might have rendered that victory less advantageous to the Germans, and less fatal to the cause of France.

Overweighted by superior force, *over-matched in artillery*, the French troops fought with a desperate gallantry, which it seems almost superfluous to praise. Conceding to the German troops the meed of admiration which their valour and discipline must command, those who have viewed the scenes of this campaign cannot fail to bear witness that it was equalled by the soldiers of France, who, fighting in an attitude not fitted to their national characteristics, were yet led by their chiefs to the attack over ground deluged by the fire of their enemies.

It is not our purpose to enter into the discussion of that part of the subject which concerns General de Failly. In the first place, the fault lay with the plan of the French Staff, which allowed the fractions of the Army to be so widely separated, and in that organisation which did not secure the inter-dependence of the various Army corps, nor keep each Commander accurately informed as to the positions taken up by the divisions of the others.

In the second place, General de Failly was not sufficiently concentrated. He mistook the *dispersion* of his troops for observation, which latter operation could have been performed by cavalry and by outlying small detachments. This fault may also be traced to his instructions which bade him keep up communication both with Frossard and McMahon.

Lastly, viewing the actual position of his divisions, we may say, that had he taken action at once on the evening of the 5th, when he received McMahon's telegram, he might have reached the field of battle with a considerable portion of his corps.

The infantry might have crossed by the tracks which run by the road, and over the mountains, and also marched by the railroad, the artillery and cavalry by the excellent road from Bitsche to Niederbronn.*

* Not a mere "mountain-road," as stated by the author of "Gedanken und Betrachtungen."

Prompt action on the part of De Failly, absolute subordination to the order he received, would probably have greatly lessened, though it might not have completely averted the disaster which befal the French arms.

The German Tactics.

In considering the tactics employed by the Germans at this battle, we must remember that much is hidden, unless we know the history of the conduct (*i.e.*, the tactical leading) of each battalion. The general result is success; but tactics become comparatively easy when we possess a preponderance of artillery, and such a superiority of force as to enable us to turn an enemy on *both* flanks. Again, the configuration of the German frontier gave the Crown Prince tactical and strategical advantages in addition to those secured by superiority of numbers. Direct retreat upon the Rhine, over which pontoon bridges could be thrown in twenty minutes, would have brought him upon part of the German base, so that beyond the fact of his superior forces, the attacks made on the outer strategical flank of the French, both at Weissenburg and Wörth, lost nothing to the general strategical situation.

We have before alluded to the question of the tactical flank by which it was most desirable to attack. The French right flank offered certain advantages. It was not strongly occupied (but this could not have been known at first); an attack upon it endangered the Marshal's principal line of retreat (presuming the Crown Prince knew of the advance of the IInd Army, or could calculate upon its position, 5th and 6th August); and even supposing Bitsche remained a good line of retreat for the French, a strong development of pressure upon their right would force the French Army into the narrow limit of the Niederbronn Pass. The French right, however, was tactically a strong position, it completely commanded the low ground; and it does not seem too much to say, that the plain country below it would be almost impassable were the Morsbronn line of hill and S. held by artillery and infantry. The only way would be to turn the line by a long detour, and so gain the second parallel position on the W. hills of the Eberbach Valley.

On the other hand, the French left offers many advantages to troops so skilled in wood fighting as were the Germans, and the advance is well concealed. Altogether, if it had only been possible to attack by *one* flank, the left flank is that which offers the most advantages with the least sacrifice of life.

The action of Wörth, as is well known, was not fought upon any forethought-out plan. It was begun by the enthusiasm and eagerness of the troops, and the desire of the Commander of the advanced guard of the Vth Corps to entangle the French in fight, and to prevent a suspected retreat. It continued in the gradual deployment of the advanced troops, under cover of their artillery, well to the front. It developed in the gradual mastery of ground and positions, under the protection of a powerful artillery. It culminated in the capture of the keys of

the French position by direct attack, while the flanking corps swept round and encircled the French wing.

The presence of the Crown Prince earlier on the field might have obviated the mistakes which led to the attack on the French left being suspended for some time. This was the critical moment, for it was then just within McMahon's power to concentrate from left to centre, and break the force of the German attack, which at that time was slight.

In the first weak attack upon Wörth, and in subsequent endeavours to pass over ground swept by the French fire, German Commanders showed a disposition to hold life cheap, when the sacrifice (looking at their superior force) was not completely necessary.

That the extraordinary efforts of the German troops were successful, is due to their admirable courage and discipline, and to their military education, physical and mental. With a greatly superior artillery, and the power of flank attacks, it appears to be a question whether any Commanders are justified in sending large bodies of troops across such open ground as the valley of the Sauer.*

The handiness of the Prussian company column shewed itself at Wörth; the men rushed across the open, sometimes forming up where cover presented itself, sometimes continuing in extended order, but they had not then gained the bloody experience of the absolute necessity to adapt all formations both to ground and the opposing fire—an experience which all their military education did not give them, until 6,000 of the Prussian Guards had been sacrificed on the slopes of St. Privat.

Of the excellent service of the Prussian cavalry, of the Prussian Staff, the independence, and yet union, of the Corps Commanders, time only permits us to mention with admiration.

The power of the artillery; the early development of its fire; the preparation made thereby; the concentration in large masses because the ground on their side required it, and because it was necessary to do so, in order to concentrate fire upon certain points of the French line, are all points especially deserving of note.

The Influence exercised by the Battle of Wörth upon subsequent Operations.

It is not difficult to trace the disastrous influence the defeat at Wörth exercised on the succeeding operations of the French Army. The right wing (McMahon) of that army could make no fresh stand against the victorious IIIrd German Army. The passages of the Vosges lay open to the enemy, the Vth French Corps (De Failly) was isolated, and the retreat of that corps and of the Ist Corps, gave the IIIrd German Army the line of operation towards the right of the great line of defence formed by the Moselle. Had the right of that line, viz., Frossard, been maintained by the right wing of the French Army, the Ist and IInd German Armies could not have crossed the Moselle, and fought the battle of the 16th August, Vionville, on a line absolutely parallel to their line of communications, or that of Gravelotte on the 18th, ab-

* The 21st Division, XIth Corps, lost 4,000 men in their efforts to cross.

solutely on a line perpendicular to the line of communication with, and facing their own base. The delay necessary to force the Moselle, would probably have given Bazaine time to retreat upon Chalons, upon which place also the right wing of the French Army would have converged.

In the actual state of the case, the French right wing was, part of it, on the 15th at Chalons; the German line was on the Moselle prolonged and secured by the IIIrd German Army at Nancy.

The garrison at Strasburg was paralysed, and although at first sight the Germans fought at Gravelotte in the manner described, they really fulfilled every condition of security because the line of railway, Ars-Frouard-Nancy-Luneville-Saverne, was in their hands, and they were fighting perpendicular to that line, which was an available line for supply and communication. It seems, therefore, unfortunate that McMahon and De Failly should not have endeavoured to halt on the Moselle line, instead of retreating by Luneville, Neufchâteau, and Charmont. With the aid of the railway they might have at least gained Pont-à-Mousson, or have joined hands with the Army of Metz at that place.

The able author of "Gedanken und Betrachtungen über den deutsch-französischen Krieg der Jahre 1870–71," considers that McMahon should have concentrated at Brumath, and that Hagenau on the line of the Möder offers a good defensive position; that forced from this, McMahon could have taken up a position at Brumath on the line of the Jura; that this would have given time for De Failly, and the VIIth Corps (Douay) to join him, and that his eventual line of retreat could have been by Belfort—Besançon—Lyons. He further remarks that the ground traversed by the stream flowing from the Vosges offers good defensive positions. In the first place, reasoning by analogy, can we believe that McMahon driven from Hagenau, could have reformed at Brumath? And supposing he had been able to do so, how would De Failly have joined him? The IIIrd German Army would in its onward march to Hagenau and Brumath, have taken good care to destroy the railway connection between Bitsche and Hagenau, by employing their cavalry for that purpose, and De Failly would have only reached Brumath by a long detour by road W. of the Vosges Mountains. The superiority of the IIIrd German Army to any force McMahon could collect, would have overpowered him at Brumath, he would have been off the direct line of retreat to Paris the moment he quitted Brumath to retire towards Belfort, and so far from chaining the IIIrd German Army, it would have been able, just as it actually did, to secure the right of the French Moselle line of defence, and thus operating on one strategic front with the IInd and IIIrd Armies, have assisted those armies in their operations against the Army of Metz. Had the Army of McMahon been of sufficient strength, a position like Saar-Union would have offered more advantages, as it would have been central to attack the enemy's columns debouching from the Bitsche and Phalsburg passes and those intermediate. De Failly might have fallen back by Saargemünd and the general line of the French Army would have been from Saar-Union—Saaralben—St. Avold. But the first real line

of defence was doubtless the Moselle. The position of Wörth was false strategically, and its tactical value was illusory. Both De Failly and McMahon were practically isolated from the French left, and the dispositions of these corps, and their action, shew fully that the French Head-Quarter Staff did not possess the power, nor the army the organisation, to change an offensive plan into one requiring a defensive attitude, by a transition sufficiently rapid and skilful to concentrate their scattered forces against the tide of the German advance.

The Tactical Lessons of the Battle.

In considering the tactical course of the battle of Wörth, the question naturally occurs, as to what formation a British Army would have adopted in the attack of a similar position? and in what manner would it have been formed for the defence of a position such as the French held? Unless these questions are answered in some way, unless we attempt to draw instruction from the terrible experience of such wars as 1866 and 1870–71, and to learn the lessons set so plainly before us, little benefit can accrue from a study of these campaigns. In answering the question as to what formation a British General would have adopted in attacking the position of Wörth, we can only consider what are the regulations at present in force.* According to these the advance of the main body would have been preceded by skirmishers. Probably in some parts of the field these would have had "supports" and "reserves" while in other parts of the ground, these last could not have been needed.† The relative distance of these supports and reserves might have been modified according to circumstances of the ground provided the officers were fully alive to the requirements of the case.

As soon as the enemy's zone of fire was approached, deployment into line would have been effected, either from columns of march or masses; the advance would have been made by brigades, or divisions in line, with a second line at the distance equal to the front of two battalions or about 800 paces (assuming the battalion to be at its war strength), or the second line might have been formed by columns of half battalions.

The attack on Wörth itself might have been made in an echelon-formation from the centre, both wings refused. At enormous sacrifice of life, if the line formation had been adhered to, the enemy's artillery from Elsashausen, and its musketry from the enclosures of Wörth, playing upon the advancing lines, Wörth would have been taken by a gallant rush at last. Then the dangerous time would approach—descending the open slopes in long lines, attempting to gain successively the

* Since this was written, marked progress has taken place in the tactical instruction of the British Army, and the late orders on this head recognise the altered conditions of things.

† "Supports are not usually required in front of a line deployed, or of a line of "columns at deploying intervals." . . . "A reserve is only needed when a battalion "is skirmishing alone, or at some distance from the force it covers."—"Field Exer-"cise," 1870, p. 205.

ground on either side of Wörth on the enemy's line, by the echelon-movement, the loss of life would have been crushing, and perhaps even the staunchness of English soldiers would not have availed against the constant fire of the breech-loader. A desperate effort would be made to storm the heights; the favourite weapon of the British soldier, "cold steel," would be employed, but with what result? As they breasted the crest of the hill, the breech-loading fire of the enemy would receive them, never giving them a chance of closing and using the bayonet; a shattered remnant might succeed in gaining the shelter-trenches of the enemy, but only to be destroyed or driven back by the arrival of fresh troops.

The British General would have recognised the value of gaining the lower part of the Elsashausen Niederwald; but what formation would have been adopted in crossing the meadow-valley swept by fire so as to gain the wood with the least loss of life? The answer is scarcely provided for by our regulations. It would be idle to believe that at this point the Prussians shewed any peculiar tactical superiority. If the company column was employed, it was particularly unsuited, and the fact that here they lost 4,000 men proves not merely a desperate resistance by the French, but that the formations were such as to expose the troops unnecessarily to the French fire. Is it presumptuous to say that the only method by which to attack this important point would be by a concentric formation in extended order? so that up to the last moment the troops should be exposed as little as possible to the danger of a close formation, and yet after gaining the edge of the wood in strength and obtaining the protection its trees afforded, be successively reinforced and pushed on. The British Commander, presuming that the force at his disposal was not superior to that of the enemy, might have attacked the enemy's left through the woods, and would probably have succeeded in gaining the plateau of Neuweiler; but with the failure of the effort against the enemy's centre, this success would have been dangerous, and when the pressure on the centre was withdrawn, the enemy would have overwhelmed the right wing of the British Army.

There remains to be considered whether the artillery would have been sufficiently forward on the line of march to cover the deployment of the advanced guard, and in what formation it would have been posted, and whether the present so-called reserve artillery of a British Corps d'Armée would have been held in reserve, or employed early in the action.

Perhaps we may reply in the negative to the first point; to the second that if the British General and Commander of Artillery recognised that the ground was more favourable to the concentration of fire by massing guns, than by an attempt at dispersing the guns and concentrating the fire, the result would have been satisfactory to the British side, so far as regards the action of the artillery. On the other hand, perhaps the "reserve artillery" would answer to its title, and this important portion of the force, together with the reserves of infantry which would have been massed in a position of safety, would probably only have covered the withdrawal from an attack which

had failed in consequence of the shattering of the close formations adopted.

If we turn to the tactics which would have obtained in a defensive position such as the French held, the tactics which would have been employed by a British Commander whose mind was free from the modern innovations introduced by foreign nations in continental wars, we should possibly see errors less fatal than those we have ventured to allude to in the supposed attack upon the same position.

Just as the French Commander did, we should endeavour to line the crests of the hills with shelter-trenches. A company of 30 files could occupy a trench 62 feet long; we should try and hold every part of the line instead of the salient defending points, and sweeping the intervening spaces by fire, and, consequently, our line could not be of sufficient extent to prevent or withstand the flanking movements the enemy would adopt to avoid the sacrifice of life in frontal attacks. Our reserves would be massed too much, and would not be employed early enough for decisive effect, and the "artillery reserve" would be held unused until its fire would no longer conduce to a victorious result.

But here we may fairly suppose the aptitude of the British soldier to defensive fights would come into full play. Our artillery dispersed but concentrating fire, in the earlier phase of the battle would have done good service. In the later development of the fight it would have perhaps been massed, according to the direction of the enemy's line of attack. The tenacity of the troops, and the protection afforded by the shelter-trenches, would have enabled them to hold their ground, notwithstanding the severe fire of the enemy and the close formation of our troops. Then, if our flanks were still safe, we should be tempted by the repulse of the enemy to call on our men for an offensive effort. Springing from the shelter-trenches, and sweeping down the slopes in those grand red lines which have so often promised victory by their mere appearance, and which have so often fulfilled it gloriously, we should abandon our advantages, and give ourselves up to the murderous fire of the breech-loader. Slightly checked at first, the onward charge would slacken in speed and fail in numbers, and when we gained the hill where we hoped to find decisive victory, we should perhaps find instead only weakness of effort, or even disastrous defeat.

These may be considered too highly-coloured pictures of the attack and defence of a position such as Wörth by a British Army employing only the tactics which are taught in our authorised books. Let those who deem them to be so, study carefully the tactical instructions issued by Feldzeugmeister von Benedek to his troops in the year 1866, at the outset of the great struggle between his country and Prussia. Then let them turn to the numerous histories and accounts explaining the causes of the Austrian defeats, and they will find most surely that these were due to the close formations and implicit trust in the power of the bayonet, errors which were fatally intensified by the superiority of the Prussian arm.

It is beyond the intention and the abilities of the writer to attempt a full discussion of the tactical modifications which should be introduced in our service to suit the changes in the power of infantry and artillery fire.

The objects that we must keep in view, are the maximum development of our own fire, with the minimum exposure to the enemy's. In the attack, we must add to these, a necessary cohesion in order that our advance may be under control and that the soldier may be led and directed by his own officers. In the defence, this cohesion would generally be obtained by the nature of our attitude. The company column of the Prussians is well known. To a certain extent only it fulfils the conditions of the problem. The attack on the Geisberg at Weissenburg was made in the first instance by company columns, and was repulsed with great loss. The attack on St. Privat at the battle of Gravelotte, 18th August, 1870, was made in lines of company columns (in two lines), with skirmishers in front. In ten minutes the Prussian Guard lost 6,000 men, and the attack was broken off. It was only when the French ammunition was exhausted and the Saxon Corps turned the flank by Roncourt, and in concert with the re-formed Guard, advanced concentrically upon the position that St. Privat was taken.

The experience gained by the Prussians convinced them that "the attack in open order, joined to the attack of skirmishers, was adopted as the only efficacious one, and it was strictly forbidden to lead close bodies of troops within a nearer distance of the enemy's fire than 2,000 paces."

Up to a late date, the column was the formation used by continental armies in attack.

Against this it has been our privilege and pride to employ the line formation, and further than this, we are the only nation who received the charge of cavalry in that attitude. We have, therefore, some claim to having taken the initiative in adopting a thin formation.

The Englishman may turn with justifiable pride to the glowing pages of Napier to see the manner in which British soldiers, *less exposed* in their thin formation, but firm because of the training and national qualities, were enabled to *develop their fire to its fullest effect*, and then drive back the shaken enemy.

If then the qualities of our soldiers were such that they could, in those days, outvie other nations in their comparatively extended formation, which with the weapons of those times gave the maximum amount of fire and the minimum amount of exposure, can we not hope that we may still preserve our superiority by adhering to the spirit though not to the letter of those infantry tactics which have so often commanded the admiration of our bitterest foes. The change is inevitable. If ever we again engage a European foe, we shall not be able to sacrifice human life unnecessarily, as the Prussians did in the war of 1870–71, and yet reap the fruits of victory. Time and men will be wanting, and the sacrifice to Moloch will only forerun our own disaster and destruction. Peace is the breathing-time in the race for national existence.

We cling to the line-formation, as that in which British soldiers have fought and conquered; but if we do not in time of peace deeply ponder whether the changes of later years and the cruel experience of other nations have not made it imperative to modify the form while we adhere to the spirit, we shall have studied to no purpose, or have

thrown away those lessons which the bitterness of defeat may recall sharply but too tardily to our minds.

Let us then take the company at its war strength, and apply to that unit the principles of the Prussian company column. It would be far handier for a column formation, when cover permitted concentration, and when in extended order, would be more under the control and direction of its officers than the Prussian company, 250 strong. But if it be considered that this would make our unit too small, we might take the mean between the two. So long as an unwieldy unit is not adopted, the exact number is not important; all that we have to provide for is, that our organization in time of peace shall correspond with that we intend to adopt in time of war, both in tactics and in administration.

Trial under officers of tactical ability would soon teach us in our peace manœuvres exactly what strength of company was adapted to our power of obtaining cover and the necessary cohesion which must subsist between the companies of a battalion. British soldiers have hitherto advanced to attack in line, "shoulder to shoulder;" let them now be taught to manœuvre for attack in extended order in line; let the companies be instructed to form columns when cover permitted; again to open out for advance and fire-development at intervals between each file corresponding to twice the ordinary length of a man's arm, concentrating at the last moment for those attacks to gain certain points on a field of battle, which must now be mastered by a concentric fire and attack converging, and uniting at the point to be mastered, though not before.

It is not pretended to lay down how the exact formation of the company column should be effected. Indeed, the word column would almost be a misnomer. What we desire to shew is, that in the future, the British soldier should be taught to use the *close* line formation when the ground covers it, or even a species of column, if that be more applicable to the ground; that he should be instructed to open out for advance in extended order, alternately closing and opening out according to the requirements of ground and fire.

With the battalion, the instruction would tend to preserve the cohesion of movement required, so that we may govern the direction of our attacks.

We have not touched on the formation of a first skirmishing line. The value of skirmishers is well recognised in our service. Let those who are inclined to wonder that our tactics have made no great strides since the days of our Peninsular victories, and to give unqualified admiration to everything wearing a Prussian aspect, turn to their drill-books prior to 1861. There they will find that the value of skirmishing fire was systematically under-estimated, and that Prussian officers were taught to employ as *few skirmishers as possible.*

Our system of musketry instruction is excellent, but in this as in other things we seek too much to bring all to one level, rather than develop the aptitude of the few. The formation in each battalion of companies of marksmen is greatly to be desired, and we cannot doubt that the employment of these as skirmishers, creeping within musketry

range of the enemy's artillery, would be productive of important military results.

In wood-fighting, also, should our troops, regular and auxiliary, be constantly practised. Such a species of combat has developed itself to an extraordinary extent, and we should try and prepare by practice in our own land, so that however remote we may regard the possibility of its application in our island-country, we may be ready for what the future day may bring forth.

In defensive fighting we should teach ourselves the value of a less deep formation, and the extension of men to ground.

Our flanks covered by natural protection, or by field works, our shelter-trenches not continuous, but like the bastions of a fortification, and our men disposed in those trenches, in the proportion of one man per yard.

Our reserves drawn up, not in solid masses, but varying in formation to suit the ground, and ready to support any portion of the line; our artillery protected by gun-pits in positions favourable for concentration of fire; and our cavalry disposed so that they may be ready to undertake offensive action against shaken infantry; with these conditions may we not believe that in fighting a defensive action our military history will repeat itself, and that our soldiers tenaciously holding to the spirit of our old line-formation would repulse the attack of the most audacious foe, seizing victory when the shattering effect of their fire had overwhelmed the enemy, and advancing, as of yore, in lines which fulfilled the qualities of the old formation, while in their more extended order they partook of the change which years have brought about in the new order of things.

Fascinating as the subject is to the soldier, we feel that we have already far exceeded the limits of an essay; but before we leave this portion of the subject may we be permitted the remark, that in modern warfare as in the old, the physical education of the soldier requires the most careful attention. The physical attributes of the German soldier permitted them, after severe marches, to master the slopes of Wörth, and the steep heights of Spicheren. While we should be far from desiring that the soldier should be altogether relieved of his valise, may we suggest that sufficient margin should be allowed in transport, so that as soon as absolute contact with the enemy is foreseen, he might be rendered more capable of enduring the fatigue consequent on marching and battle, and the passage over ground in the swiftest manner?

In the autumn manœuvres, we might also see how our ammunition-columns answered to supply the regimental reserves in action by issuing only a few rounds to the men for an engagement, and when those few rounds were exhausted, by allowing them to be dependent upon the ammunition columns.

We cannot refrain from expressing a belief, that adherence to the spirit, while we reject the form, of our old close line-formation, is eminently suited to that army which must bear the brunt of a European contest, or of Oriental warfare. On the plains of India against an ill-armed or irresolute foe, the wise Commander would be

inclined to employ the closer formation in line, against the loosely-bound masses of an Eastern adversary. The occasion alone could decide the method of attack. In the little wars which Russia is now carrying on over the steppes of Central Asia, we are told that the defenders of the country are as little inclined to attack a line of skirmishers as a close formation. In a word, even in those remote regions, the truth has been appreciated, that with the new arms rapidity of fire supplies the place, and the close formation of numbers.

In artillery, so far as regards *matériel* and technical training, we have little to learn from foreign nations, while its tactical training, and the art of handling it on the field, will probably receive increased attention. It does require, however, greater stress to be laid on the necessity for extreme accuracy of fire. Slowness of fire, if accompanied by great accuracy, should be regarded as a virtue. We would go a step further, and say that it should be an accepted axiom that at drill, and with blank ammunition, not only should the guns be deliberately laid each time they come into action on objects whose range should be ascertained by a range-finder, or given by the subalterns of divisions, or Nos. I; but every operation should be performed save those connected with the fuze and projectile, which could only be undertaken at practice or in actual battle, and that even these should be impressed on the minds of all by the means of "motions."

That England ought to excel in her artillery is now a recognised axiom. The arguments against a powerful artillery are the encumbrance which it entails. Whether this evil cannot be greatly lessened by an increase in the number of guns in a battery, retaining the same number of non-fighting carriages (in which term we include all except guns, limbers, and ammunition waggons), is a point which may well be discussed by superior and experienced artillery officers.

In the cavalry much is being done to fit that arm for the requirements of the day. Those requirements, exemplified by the performance of the German cavalry during the war of 1870–71, are too well known now to need repetition here. A simplification and further lightening of the equipment may be found practicable. Our cavalry officers are not surpassed as horsemen by any body in the world. It only needs a mastery of subjects comprised under the heads, "Outpost duty," and "Reconnaissance," to render them superior to that of other nations in every respect.

Let us then freely learn the lessons which are so clear, that those who run may read. By attentive study of theory founded on the bloody experience of other armies, let us constantly practice to apply our theory to ground. Let us not hinder the military education of our troops by a retention of drill manœuvres, which waste valuable time to no purpose but those of show and parade.

First, let us try and continually practice our troops in small, as well as large bodies over as varied ground as circumstances will permit, and in accuracy and development of fire, and then we may fall back on the harmless exercises of the barrack-square.

It is not that our troops require less drill, but *more*—only drill on the parade and in the field used as means to an end, and not as the end itself.

Whether we shall see in action the great step towards sound military organization which has been proposed by the present War Minister, time alone will show. Even when this is carried out, much still remains to be done. It is not necessary that we should blindly copy a foreign model; we must adopt one suited to our national character, or it will fail. But unless we consent to form tactical units of command, and to decentralize our administration, our reforms in other directions will be of little value.

There are those—and we go far with them in admiration—whose worship of the German Army, which has achieved such great things, extends to the belief in the innate superiority of the German over the Frenchman. Let our minds travel back to the days of Jena and Auerstadt, and we shall find there a history we shall do well to apply to ourselves. Then, as in these times, a nation rushed blindly to arms, unassisted by allies, but confident in the patriotism of its people, and in the past glory achieved by its arms under a great warrior. Then, as now, the military Commanders were blind to the changes in tactics and organization which the march of time had hurried on; then, as now, they sought to cover ignorance by bravery.

Then followed, as in the year 1870–71, disaster upon disaster; the army became demoralized; then, as now, came the entry into a capital, a humiliating peace, a deprivation of provinces, an enormous indemnity burdening the exhausted country. In 1806 it was Prussia that fell a victim to its own blindness and the power of the French. In 1870–71 it was Prussia that made France pay the debt of revenge. History repeats itself with terrible exactness. England, and rightly, detests war. No ideas of foreign conquest or military glory obtain possession of our minds. We would have all the world be at peace. But not the less should England keep bright her sword for those evil days which may yet come, when she may have to fight for the widespread heritage bequeathed to us by our forefathers.

LECTURE.

Friday, May 23rd, 1873.

General the Right Honorable LORD STRATHNAIRN, G.C.B., G.C.S.I., in the Chair.

[*This paper was read by Captain Tyler, in the absence of Mr. Andrew from illness, and at his request.*]

THE EUPHRATES VALLEY ROUTE TO INDIA IN CONNECTION WITH THE CENTRAL ASIAN QUESTION.

By W. P. Andrew, Esq., F.R.G.S., Chairman, Scinde, Punjaub, and Delhi Railways.

[Captain Tyler : Mr. Andrew has for the last twenty years devoted much time and attention, and been at considerable expense, in advocating this route. I am sure therefore that the meeting will hear with interest all that he has entrusted me to deliver to it on the subject.]

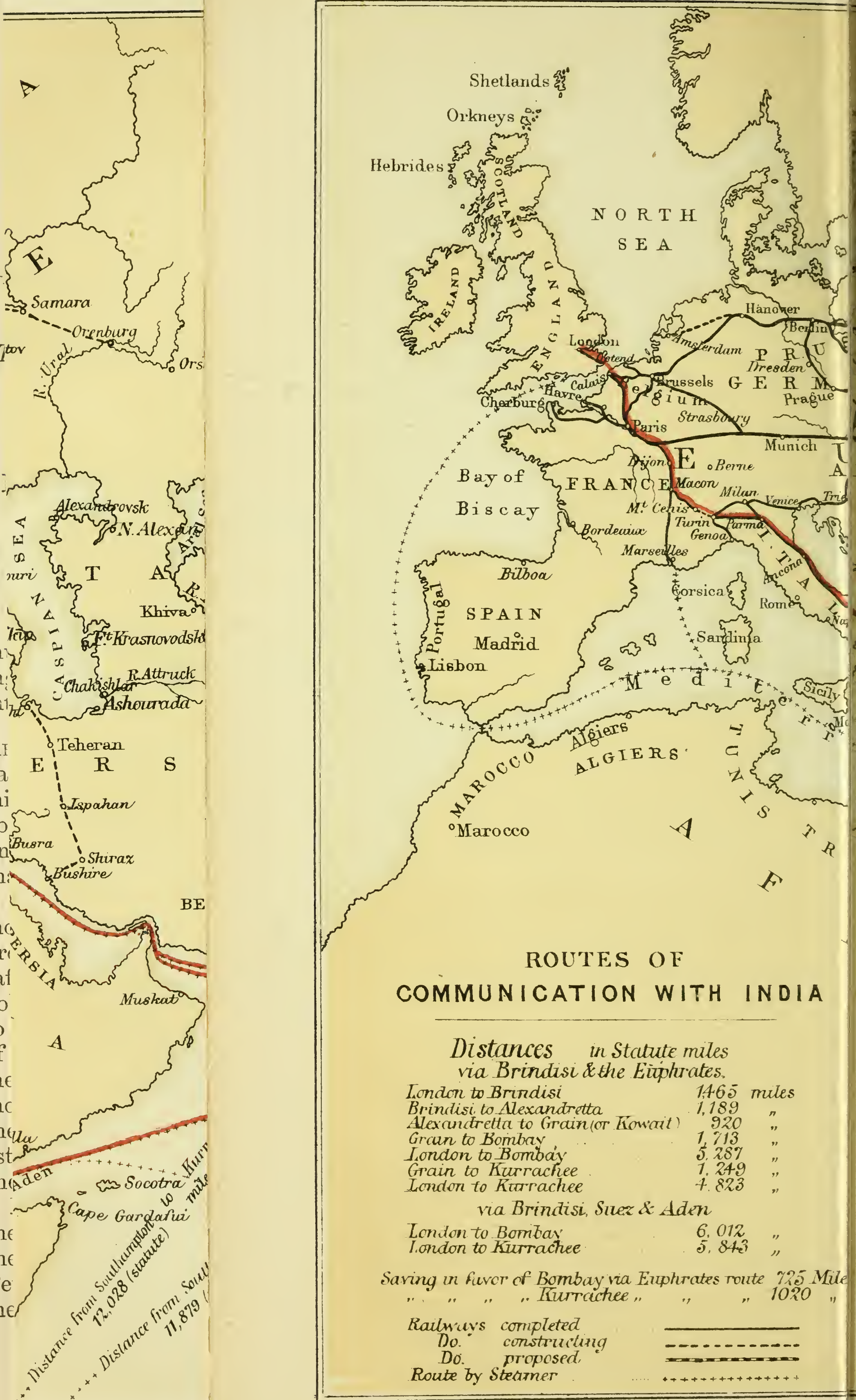
After a comparatively lengthened slumber, the Central Asian Question has recently again awakened into prominence. Seldom has the public mind,—I may say of Europe,—been so completely engrossed by a political question, owing its importance rather to the magnitude and uncertainty of the events to which it may at a future time give rise, than to its more immediate and palpable consequences.

Here in England it is not surprising that the recent portentous movements of Russia should excite men's minds, and fill us with apprehensions for the maintenance of our prestige in Europe and the safety of our Empire in the East. But while in our desire to avoid political complications we have devoted ourselves, with much assiduity, to the discussion of geographical questions affecting the boundaries of neutral States, we have overlooked the simplest and most obvious means of checkmating the possible designs of Russia by a parallel movement along the Valley of the Euphrates. It is right, therefore, at the present juncture, once more to invite attention to the proposed establishment of a direct and rapid route to our Eastern possessions by the ancient highway of the Euphrates.

In the proposal to restore this ancient route—once the highway of the world's commerce and the track of the heroes of early history—by the construction of a railway to connect the Mediterranean and the Persian Gulf, we have at hand an invaluable and perfectly efficient means at once of thwarting the designs of Russia, if they should assume


ROUTES OF
COMMUNICATION WITH INDIA
Distances in Statute miles
via Brindisi & the Euphrates.
London to Brindisi 1465 miles
Brindisi to Alexandretta 1,189 "
Alexandretta to Grain (or Kowait) 920 "
Grain to Bombay 1,713 "
London to Bombay 5,287 "
Grain to Kurrachee 1,249 "
London to Kurrachee 4,823 "
via Brindisi, Suez & Aden
London to Bombay 6,012 "
London to Kurrachee 5,843 "
Saving in favor of Bombay via Euphrates route 725 Miles
" " " " Kurrachee " " " 1020 "
Railways completed
Do. constructing
Do. proposed
Route by Steamer
Distance from Southampton to Kurrachee 12,028 (statute) miles
Distance from Southampton to Bombay 11,879 (statute) miles
NORTH SEA
BALTIC SEA
BLACK SEA
CASPIAN SEA
Mediterranean Sea
Bay of Biscay
RED SEA
GULF OF ARABIA
G. OF PERSIA
G. of Aden
BAY OF BENGAL
EUROPE
RUSSIA
ASIA
OMSK
TARTARY
TURKEY
PERSIA
ARABIA
SYRIA
AFRICA
EGYPT
NUBIA
ABYSSINIA
BELOOCHISTAN
CABUL
HINDOOSTAN
DECCAN
THIBET
Nepaul
GERMANY
AUSTRIA
FRANCE
SPAIN
ITALY
ENGLAND
SCOTLAND
IRELAND
Portugal
MAROCCO
ALGIERS
TUNIS
TRIPOLI
Shetlands
Orkneys
Hebrides
L. Onega
St Petersburgh
Moscow
Samara
Orenburg
Saratov
Orsk
Tobolsk
Semipolatinsk
Warsaw
Hanover
Berlin
Breslau
Amsterdam
Dresden
Prague
London
Ostend
Calais
Brussels
Havre
Cherburg
Paris
Strasbourg
Munich
Vienna
Dijon
Berne
Macon
Mt Cenis
Milan
Venice
Trieste
Turin
Parma
Genoa
Bordeaux
Marseilles
Bilboa
Madrid
Lisbon
Corsica
Sardinia
Rome
Ancona
Naples
Brindisi
Avlona
Sicily
Malta
Candia
Cyprus
Belgrade
Widdin
Scutari
Adrianople
Constantinople
Varna
Odessa
Sebastopol
Karlsburg
Galatz
Smyrna
Adalia
Alexandretta
Aleppo
Beyrout
Damascus
Jerusalem
Alexandria
Cairo
Nile
Djedda
Mecca
Macalla
Aden
Muskat
Socotra
Cape Gardafui
Marocco
R. Dvina
R. Dnieper
R. Don
R. Volga
R. Ural
R. Euphrates
R. Tigris
Rostov
Astrakhan
Petrovsk
Khanschouri
Poti
Tiflis
Baku
Trebizond
Erzeroum
Diarbekir
Mosul
Resht
Teheran
Ispahan
Bagdad
Kerbelae
Nedjef
Bussora
Grain or Kowait
Shiraz
Bushire
Alexandrovsk
N. Alexandrovsk
Aral Sea
Sir Daria (Jaxartes)
Turkestan
Khojend
Kokan
Khiva
R. Amoo or Jihon (anct Oxus)
Krasnovodsk
Bokhara
Samarcand
Kashgar
Yarkand
R. Attruck
Charjui
Chakishlar
Ashourada
Merve
Herat
Cabul
Khyber Pass
Peshawur
Attock
Cashmere
Candahar
Lahore
Umritsir
Kelat
Bolan Pass
Moultan
Meerut
Delhi
Agra
Allahabad
Patna
Kedji
Hydrabad
Kurrachee
Baroda
Calcutta
Nagpoor
Bombay
Sholapore
Goa
Bungalore
Seringapatam
Madras
Mahe
Negapatam
Madura
Trincomalee
Ceylon
Point de Galle

J. Jobbins



ROUTES OF COMMUNICATION WITH INDIA

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Railways	completed	———
Do.	constructing	- - - - -
Do.	proposed	—·—·—
Route by Steamer		+ + + + +

a hostile character; of marching hand in hand with her if her mission be to carry civilization to distant lands; and of competing with her in the peaceful rivalry of commerce.

On every ground, therefore, the proposed Euphrates Valley Railway is an undertaking eminently deserving our attention and the support and encouragement of our Government.

The countries which our future highway to India will traverse have been, from remote antiquity, the most interesting in the world. On the once fertile plains, watered by the Euphrates and Tigris, the greatest and most glorious nations of antiquity arose, flourished, and were overthrown. The earliest home of the genius of civilization—the scene of great events in the early history of the world—now shrouded in the dust of ages, or dimly discerned through the long vista of many centuries—the land of the Assyrians, Babylonians, and Chaldeans; where the daughters of Zion sat down and wept; where lay the track of Xenophon and his heroic 10,000 Greeks; the centre of the conquests of the Macedonians, where once stood the proud capitals of the Sassanides and of the Caliphs, now deserted and tenantless,—these regions must ever possess a fascination and interest for all mankind.

Somewhere on the banks of the Euphrates all scriptural commentators place the Garden of Eden. The second cradle of the human family was also upon that river, or its tributary, the Tigris. The first city of the new earth was built upon its banks. The tower of pride, erected by the post-diluvian population, cast a shadow over its waters. The Euphrates intersected Babylon, the "Golden City," the "Glory of Kingdoms;" the great capital of the Chaldean Empire; now a desolation among the nations—her broad walls utterly broken; her high gates burnt with fire. With Babylon are associated the names of Nebuchadnezzar and Belshazzar; of Daniel and Darius; of Cyrus and Alexander. The grand prophet of the captivity, and the energetic apostle of the new era, had their dwelling within her walls. Ere even a brick was made upon the Nile, Nineveh and Babylon must have had thriving and busy populations.

Twice in the world's history, mankind commenced the race of civilisation on the Mesopotamian Rivers. Twice the human family diverged from their banks to the east, the west, and the north. Arts and sciences made the first feeble steps of their infancy upon the shores of these rivers. Very early in history we know that Babylon was a great manufacturing city, famed for the costly fabric of its looms. At a more recent date the Chaldean kings made it a gorgeous metropolis, the fairest and the richest then on earth. Alexander of Macedon made it the port of the Indian Ocean and the Persian Gulf, and he proposed to render it the central metropolis of his empire.

The countries through which the Euphrates flows, were formerly the most productive in the world. Throughout these regions the fruits of temperate and tropical climes grew in by-gone days in luscious profusion. Luxury and abundance were universally diffused. The soil everywhere teemed with vegetation. Much of this has since passed away. Ages of despotism and misrule have rendered unavailing the bounty of nature. But the land is full of hidden riches. The natural

elements of its ancient grandeur still exist in the inexhaustible fertility of the country, and in the chivalrous character and bearing of many of the tribes; and the day cannot be far distant when it is destined to resume its place amongst the fairest and most prosperous regions of the globe.

The wondrous fertility of Mesopotamia was in early times carried to its utmost limit by means of irrigation canals, with which the country was everywhere intersected, and some of the largest of which were navigable. These excited the wonder and interest of Alexander the Great, who, after his return from the conquest of India, examined them personally, steering the boat with his own hand. He employed a great number of men to repair and cleanse these canals.

Herodotus, speaking of Babylonia, says, "Of all the countries I "know, it is without question the best and the most fertile. It pro- "duces neither figs, nor vines, nor olives; but in recompense, the earth "is suitable for all sorts of grain, of which it yields always 200 per "cent., and in years of extraordinary fertility as much as 300 per cent."

These regions need only again to be irrigated by the life-giving waters pouring down ever cool and plentiful from Ararat—that great land-mark of primæval history, now the vast natural boundary-stone of the Russian, Turkish, and Persian empires—to yield once more in abundance almost everything that is necessary or agreeable to man. Many acres now wasted, save when in early spring they are wildernesses of flowers, may be covered with cotton, tending to the employment of the million spindles of our land.

It is not too much to say, that no existing or projected railroad can compare in point of interest and importance with that of the Euphrates Valley. It will bring two quarters of the globe into juxta-position, and three continents, Europe, Asia, and Australia, into closer relation. It will bind the vast population of Hindustan by an iron link with the people of Europe. It will inevitably entail the colonisation and civilisation of the great valleys of the Euphrates and Tigris, the resuscitation in a modern shape of Babylon and Nineveh, and the re-awakening of Ctesiphon and Bagdad of old.

Where is there in the world any similar undertaking which can achieve results of such magnitude, fraught with so many interests to various nations? And who can foresee what ultimate effects may be produced by improved means of communication in the condition of Hindoos, Chinese, and other remote peoples?

It is by distance and difficulties of intercourse that the distinctions of creeds and races are chiefly upheld. Annihilate space, and the great barriers that separate peoples—the differences of manners and customs, of modes of thought and feeling, of doctrines and dogmas, of precepts and prejudices, that keep up these barriers—gradually disappear, as barbarism, superstition, and ignorance give way to the superior and irresistible force of civilisation, truth, and enlightenment.

Although various routes have been suggested with the view of bringing Great Britain, by means of railway communication, into closer connection with India and her other dependencies in the East, and of securing at the same time the immense political and strategic deside-

ratum of an alternative highway to our Eastern possessions, there is none which combines in itself so many advantages as the ancient route of the Euphrates; the route of the Emperors Trajan and Julian, in whose steps, in more recent times, the Great Napoleon intended to follow, when the Russian campaign turned his energies in another direction.

The special advantages which render this route superior to all others, are briefly these:—It is the direct route to India. It is the shortest and the cheapest, both for constructing and working a railway; so free from engineering difficulties, that it almost appears as though designed by the hand of nature to be the highway of nations between the east and the west; the most surely defensible by England—both of its termini being on the open sea; and the most likely to prove remunerative.

Both in an engineering and a political point of view, the Euphrates route undoubtedly possesses great advantages over any of the others which have been proposed. All the routes which have been suggested from places on the Black Sea, are open to the fatal objection, that while they would be of the greatest service to Russia, they would be altogether beyond the control of Great Britain, while the engineering difficulties with which they are surrounded are of themselves sufficient to exclude them from practical consideration.

This has been fully established by the evidence of the witnesses examined by the Select Committee of the House of Commons, which lately investigated the merits of the various proposals for connecting the Mediterranean and the Black Sea with the Persian Gulf.

In the course of the investigation by the Committee, it was demonstrated that the proposed Euphrates Valley Railway is an eminently feasible undertaking in an engineering sense; that the route of the Euphrates and the Persian Gulf is decidedly preferable in respect of climate to that by Egypt and the Red Sea; that as regards the safety and facility of the navigation the Persian Gulf also has by far the advantage; that the proposed undertaking would be of great commercial moment, and if not immediately profitable, at all events that it would be so at a date not far distant; and finally, that it would be of the highest political and strategic importance to this country.

It is unnecessary to quote in detail from the evidence taken by the Committee, but in order to show how authoritative were the conclusions in favour of the undertaking at which the Committee arrived, I may state that the engineering facilities which exist for the construction of a railway from the Mediterranean to the Persian Gulf were demonstrated by the evidence of the late General Chesney, the veteran explorer of the route, by Captain, now Admiral Charlewood, of the Royal Navy, and Mr. W. F. Ainsworth, two of the officers attached to the Euphrates Expedition; by Sir John Macneill, Mr. Telford Macneill, Mr. W. J. Maxwell, Sir Henry Rawlinson, Captain R. F. Burton, and Captain Felix Jones. The advantages of the route, in respect of the climate and productiveness of the country to be traversed, were shown by the evidence of General Chesney, Mr. Eastwick, M.P., Captain Felix Jones, Colonel Sir Henry Green, Colonel Malcolm Green, Mr. Consul Barker,

and others. Mr. Barker, who has resided twenty-six years as Vice-Consul and Acting Consul at Seleucia, Antioch, and Aleppo, and has perhaps as intimate an acquaintance with the country as any man living, stated in an official report, addressed by him last year to Lord Granville, that—

"A railway through Mesopotamia, as a route to India, would not at "first be productive of much income to a company from traffic, but in "a few years—certainly before the railway could be finished—the "cultivation of grain would increase a hundredfold, and would go on "increasing a thousandfold, and would attain to a magnitude and "extension quite impossible to calculate, because bad harvests are "almost unknown in these parts, for there is always plenty of rain and "a hot sun to ripen the corn. Populous villages would spring up all "along the line, as there is abundance of sweet water everywhere. "Cereals can be grown there so cheaply that no country the same dis-"tance from England—say, for instance, Russia—could compete with "it at all. And if Great Britain finds it necessary to rely more on the "importation of foreign corn, where could a better field be found than "the fertile plains of Mesopotamia, the cradle of mankind, which has "all the advantages of climate, soil, sun, and water, in its favour?"

The facility of the navigation of the Persian Gulf was testified to by Mr. William Parkes, Consulting Engineer to the Secretary of State for India for Kurrachee harbour, and by Mr. Edwyn Dawes, and also, in a correspondence published a short time since, by Captain A. D. Taylor, late of the Indian Navy.

The advantages of the proposed undertaking from a military point of view were placed beyond question by the evidence of General Chesney, of Captain Tyler, and of those experienced soldiers, Sir Henry and Colonel Malcolm Green, and more especially by the weighty testimony of Lord Strathnairn; while its importance in a political sense was established by many witnesses, amongst whom I may instance Sir Bartle Frere, the late lamented Sir Donald McLeod, Mr. Palgrave, Colonel Herbert, Her Majesty's Consul-General at Bagdad, Mr. Eldridge, Consul-General at Beyrout, and, pre-eminently, the "Great Elchi," the venerated Lord Stratford de Redcliffe.

Other nations, whose interests in the East are incomparably less than ours, either on political or commercial grounds, have in recent years made great advances in extending their communications in an easterly direction.

The establishment of steam communication by the "Messageries Maritimes" on the route of the Red Sea to Calcutta and other Eastern ports shows the importance attached by the French to the extension of their commercial relations with the East. A Russian line of steamers also, has lately been established, to run between Odessa and Bombay by the route of the Suez Canal. Even those who see no danger in the policy of annexation pursued by Russia, will admit that the Russian roads and railways now being pushed towards Persia and Affghanistan, if designed with pacific intentions, prove, at all events, the anxiety of the Russian Government to compete with us for the trade of Central Asia, the Punjaub, and Northern India. But the carriages and trucks

ostensibly designed for peaceful and commercial purposes are so constructed, under the special instructions of the Russian Government, as to be equally available for the conveyance of troops and munitions of war. We must not, therefore, stand still in the career of improvement, and be left behind in the race by other nations, however friendly. Political disturbance in Europe might at any moment deprive us of our communications with India *viâ* Egypt.* So long as the Indian Empire subsists, the connection between India and this country must be kept up. If that connection were interrupted for many months, the doom of our Eastern Empire might be practically sealed. England maintains her position in India mainly by force of arms; and it is a principle both of war and of common sense to take the most efficient means at our command to keep open the lines of communication between the base and the field of operations. Hence the necessity of establishing an alternative route, even if it were not a better one. But that by the Euphrates, the most ancient of all, is at once the shortest, the easiest, and the safest, and it can never be superseded by any other offering superior advantages.

Apart from the general question of the advantage on strategic grounds of possessing an alternative and accelerated route to our Eastern dominions, it is a matter of the greatest importance that, in case of an emergency, we should be able to send troops to India at any season of the year. Viewed in this light, the Euphrates route presents a striking contrast to that *viâ* Egypt, which, during a portion of the year, could not be used for the transport of troops without a serious sacrifice of life in consequence of the excessive heat of the Red Sea. The Euphrates route, on the other hand, would be available for this purpose at all seasons.

In addressing such an audience as the present, it would be superfluous to dilate on the importance, in a military point of view, of an undertaking which would reduce the journey between England and India by several days.

The substitution of Kurrachee for Bombay as the European port of India would, even by the Red Sea route, give us an advantage of some 500 miles; but if the Euphrates route were once established, the adoption of Kurrachee as the European port of India would necessarily follow, and India would thus be brought upwards of 1,000 miles nearer to us than at present; while, during the monsoon months, the gain would be still greater, as the route between the Persian Gulf and Kurrachee is not exposed to the severity of the monsoon, which it is well known, renders a divergence of some 500 miles necessary during a portion of the year on the voyage from Bombay to Aden.

When the railway system of the Indus is completed, Kurrachee will be in continuous railway communication with Calcutta, and with the gates of Central Asia at the Khyber and Bolan Passes, and it will thus become the natural basis of operations in the event either of any internal commotion in India, or of aggression on our north-western frontier.

* "The (Suez) canal can be closed with great ease, either by sinking a ship in the " channel, or by blowing in the sides at two or three points where the banks offer " peculiar facilities for hasty demolition."—(Capt. Wilson, R.E., *vide* page 496.)

If I may repeat the words which I ventured to urge upon Lord Palmerston upwards of sixteen years ago, when I accompanied, in support of the Euphrates Valley Railway, one of the largest and most influential deputations that ever waited upon a Minister, "the grand "object desired, is to connect England with the north-west frontier of "India by steam-transit through the Euphrates and Indus Valleys. "The latter will render movable to either the Khyber or the Bolan, "the two gates of India, the flower of the British Army cantoned in "the Punjaub; and the Euphrates and Indus lines being connected by "means of steamers, we should be enabled to threaten the flank and "rear of any force advancing through Persia towards India. So that "by this great scheme, the invasion of India would be placed beyond "even speculation, and it is evident that the great Army of India of "300,000 men being thus united to the Army of England, the mutual "support they would render each other, would quadruple the power "and ascendancy of this country, and promote powerfully the progress, "the freedom, and the peace of the world."

The Euphrates and Indus lines together would, moreover, secure for us almost a monopoly of the trade with Central Asia, enabling us to meet Russia, our great competitor in these distant fields of commercial enterprise, on more than equal terms.

But it is not on commercial considerations that I would urge the claims of the Euphrates Valley Railway. It is on imperial grounds that the scheme commends itself to our support. I believe that the establishment of the Euphrates route would add incalculably to our prestige throughout Europe and the East, and would do more to strengthen our hold on India than any other means that could be devised.

On the ground of the great importance to India of being placed in continuous railway communication with Europe, some persons of an ambition too lofty and impatient to pay much regard to the considerations which weigh with more practical advocates of railway enterprise, would be content to support nothing short of a through-line from Constantinople to India.

Although fully alive to the vast importance of the results which would accrue, not only to England and India, but to the cause of civilization generally, from the establishment of continuous railway communication between Europe and India, I cannot conceal from myself that such a project is too vast to be at once undertaken with any hope of success. But the Euphrates Valley Railway as proposed from the Gulf of Scanderoon to the Persian Gulf, has been specially designed with a view to its ultimately forming part of a through-line from Constantinople to the head of the Persian Gulf, while it is capable also of being, in due time, extended eastwards to Kurrachee, the port of India nearest to Europe. The line from the Mediterranean to the Persian Gulf has been demonstrated to be eminently practicable and easy, which the other portions of the route between Constantinople and India are not. While capable of forming part of a through-line, it would at the same time be complete in itself, and independent of any disturbances in Europe—the only portion, in fact,

of a through-line of railway which would be always, and under all circumstances, at the absolute control of this country. It would always be to this country the most important portion of any through-line; and indeed I believe a through-line could not be constructed, except at overwhelming cost, without the assistance of a port in northern Syria. It would, moreover, provide us with a complete alternative route to India, and would thus at once secure to this country advantages admitted to be of the highest national moment. It is for these reasons that during the long period in which I have devoted myself to the advocacy of the Euphrates route to India, I have thought it expedient to urge upon our own Government and that of Turkey, the special claims of that section only which would connect the Mediterranean with the Persian Gulf.

The objection that, although the Euphrates Valley Railway would afford us the undoubted advantage of an alternative, a shorter, and a more rapid means of communication with India, it would still leave a considerable portion of the journey to be accomplished by sea, and that consequently it would accelerate our communications with the East in a minor degree only, is sufficiently disposed of by the circumstance already pointed out,—that a railway from a point on the Mediterranean, at or near Scanderoon, to the head of the Persian Gulf, would naturally form part of a through-line of railway from Constantinople to India, if at a future time it should be considered necessary or desirable to construct the remaining sections.

At the same time it is to be observed, that any possible acceleration of the journey between Europe and India, by the substitution of railway for sea transit, would be, relatively, much less in the case of those portions of the route traversing Asia Minor on the one hand, and Persia and Affghanistan, or Beloochistan, on the other, than on the central section between Scanderoon and the Persian Gulf; the latter section being almost level for nearly the whole distance, and therefore capable of being traversed at a very high rate of speed; whereas, both in Asia Minor and Persia, the gradients would be so severe as to neutralize in a great measure the advantages ordinarily attaching to railway travelling as compared with that by sea. *Pro rata* to the power required, so is the distance. In other words, the proposed Euphrates Valley Railway would take advantage of precisely that portion of the route between Constantinople and India, where the greatest benefit would be derivable from the substitution of railway for sea transit, whether regard be had to the rate of speed attainable, or to the economy with which the traffic might be worked.

A regular mail service being already in operation on the maritime portions of the Euphrates route to India—maintained on the Mediterranean side by French steam-packets calling at Alexandretta, and between the ports of the Persian Gulf, and Kurrachee and Bombay, by the vessels of the British India Steam Navigation Company—a railway of little more than 900 miles in length from Scanderoon (or Alexandretta), on the Mediterranean, to Kowait (or Grain), on the Persian Gulf, is all that is required to secure for us the immense political and strategic advantage of a complete alternative route to

India; a shorter and more rapid route than now exists; and one, moreover, which compares very favourably with the Red Sea route, both as regards climate, and the facility and safety of the navigation.

Both Alexandretta and Kowait, the proposed termini of the railway, possess all the requisites of first-class harbours.

The harbour of Alexandretta is one of great capacity; sufficient, according to Sir John Franklin, Admiral Beaufort, and others, to contain the whole Navy of Great Britain. It is the safest harbour on the coast of Syria, and might be made available for the purposes of the railway at a very small outlay. The place is at present open to some objection on account of unhealthiness; but this, its only disadvantage, might be entirely obviated by drainage, at a moderate expenditure.

With regard to the harbour of Kowait, near the head of the Persian Gulf, Mr. William Parkes, C.E., the Consulting Engineer to the Secretary of State for India for Kurrachee harbour, who by the liberality of the Indian authorities, was recently enabled to examine the ports in the Persian Gulf, states in an able report addressed to me on the subject, that "nothing could be more secure or favourable in any "way" (than Kowait) "for ships of the largest size, whether to ride "at anchor, or to be moored alongside a quay wall." As a place for landing and embarking passengers, mails, and cargo, even without sea works more extensive than a short jetty to bring a steam tender alongside, Mr. Parkes reports that Kowait "is superior to Alexandria (as it "is, until the new works are completed), to Suez (as it was three "years ago), and to Bombay; while for an expenditure of from 80,000*l*. "to 100,000*l*., a wharf of sufficient length to berth four steamers, of "3,000 tons each, might be constructed, and the railway brought down "upon it, thus placing Kowait on a par, in this respect, with Suez as "it is, Brindisi, or Dover." Kowait is already one of the most important towns in the gulf, and according to Captain A. D. Taylor, late of Her Majesty's Indian Navy, possesses more baghalahs, or boats of the country, than any other port in the gulf which trades with India; and there can be no doubt, if it be adopted as the eastern terminus of the railway, it will, within a very short period, have an enormous trade of its own, irrespective of the through traffic passing over the railway.

As regards the route which the railway should take between Alexandretta and the Persian Gulf, it is to be borne in mind, that the great and primary object of the undertaking is the connection of the Mediterranean Sea and the Persian Gulf by railway; and the necessity for such a connection having been once established, the precise line which the railway should take, would appear to be comparatively a matter of less vital importance. I may observe, however, that passing in the first place from Alexandretta, the proposed terminus on the Mediterranean, to Aleppo, the present metropolis of Syria, and a great entrepôt of trade, the route from that place to the Persian Gulf, which has much the strongest arguments in its favour, would appear to be that recommended by Captain Felix Jones, which keeps on the right bank of the Euphrates for the whole distance, beyond the reach of inundations, and passes by way of Annah, Hit (the Is of Herodotus), the holy cities of

Kerbela and Nedjef (or Meshed Ali), Semárwah, and Súk-esh-Sheyukh to Kowait or Grain, on the Persian Gulf.* This line would pass not many miles from Bagdad, the city of the Caliphs, a household word with us from the time we read of the doings of Haroon al Rashid in the "Arabian Nights." Bagdad, and the neighbouring holy cities of Kerbela and Nedjef, are frequently chosen by Sheeah Mahomedans as a residence, that they may be buried by the side of Hoosein, their favourite saint, whose tomb at Kerbela is the peculiar object of their veneration, and is annually bedewed with the tears of thousands. Nedjef, the burial place of Ali, though of inferior sanctity, is also held in great veneration. Pensioners of the Government of India, natives of the highest rank, frequently make Bagdad or Kerbela their adopted home; and both from Persia and Hindustan, untold wealth has been poured into the coffers of the priests of Kerbela.

The route which I have traced from Alexandretta to the Persian Gulf, besides being probably the shortest line obtainable, would obviate altogether the necessity and expense of crossing the Euphrates. This line, moreover, regarded from a strategic point of view, would give the advantage of the interposition of two great rivers between the railway and an enemy advancing on the flank on which there would be the greatest likelihood of attack.

The cost of the proposed railway, according to the estimates of competent engineers, would be under nine millions sterling; and His Excellency, Musurus Pasha, the Turkish Ambassador, has officially intimated the readiness of his Government to raise the requisite funds by means of an Ottoman loan, under conditions specially favourable to this country,† if Great Britain will give a counter-guarantee, as she

* It was originally proposed that Bussorah, at the head of the Persian Gulf, should be the eastern terminus of the railway, but from the evidence taken by the recent Select Committee of the House of Commons, it would appear that Kowait would be the most suitable terminus.

† The following are the conditions referred to:—

1. The funds required for the construction of the railway, to be raised by means of an Ottoman Loan, the interest of which to be counter-guaranteed by England at the rate of 4 per cent. per annum, and 1 per cent. for a sinking fund.

2. The proceeds of such loan, when raised, to be deposited in the Bank of England in the names of a mixed committee to be appointed jointly by the English and Turkish Governments, and to be applied by them exclusively for the construction of the railway, and the provision of the necessary rolling stock, and for no other purpose.

3. All the land necessary for the railway, and for all the works in connection therewith, to be provided free by the Turkish Government.

4. In order to secure, with regularity and certainty, the payment of the interest upon the loan, the following stipulations to be agreed upon and enforced:

(1st.) The net income proceeds of the working of the railway when made, wholly or in part of it, to be paid into the Bank of England, and applied exclusively to the payment of the interest and the sinking fund.

(2nd.) The customs duties and port charges of the ports of Alexandretta and Bussorah, as well as certain revenues and other resources of the provinces through which the railway may pass, to be assigned by the Turkish Government to the mixed committee as a security for the payment of the interest of the loan, and of the sinking fund.

5. The Turkish Government to guarantee to England the privilege of the conveyance of troops at all times by the railway to and from this country, and any of Her

has already done, jointly with France, in the case of an Ottoman loan raised in 1854.

The opening up of the Euphrates route would afford an additional guarantee for the integrity of the Ottoman Empire, and would tend in a great measure to a peaceful solution of the Eastern question. The proposed railway would consolidate the dominions of the Porte, by bringing the ancient Pachaliks of Aleppo and Bagdad into closer communication with the seat of Government. The grand impediment to the improvement of the Sultan's dominions is the want of means of intercommunication; and no line would promote more effectually their good government and prosperity, or do more to develop their really prodigious resources than that which would lay open to the energy and capital of the emigrant and merchant of the West, the extensive and fertile plains of the Euphrates and Tigris.

I believe that by co-operating with our ally the Sultan in this work of progress, we should run infinitely less risk of unfortunate complications than by the task we have lately undertaken of determining the political geography of Central Asia; while we should do much to cement our alliance with a Power whose friendship it will always be incumbent on us to maintain if we would rule in security over a population composed, as that of India is, largely of Mahomedans.*

Let me recall for a moment to your recollection the political inheritance bequeathed by Peter the Great to his successors, in his will. "We "must," says that remarkable document, which first became publicly known in 1837, "incessantly extend ourselves towards the north, the "Baltic Sea, and towards the south, the Mediterranean.

"We must advance as much as possible towards Constantinople and "India. Whoever shall reign there will be the true masters of the "world. Therefore we must face continual wars, sometimes with "Persia; create dockyards and emporiums on the Black Sea; take "possession, little by little, of that sea, as well as of the Baltic, which "is a point doubly necessary for the success of the plan; hasten the "downfall of Persia; advance into the Gulf of Persia, as far as can "be done, re-establish through Syria the ancient commerce of the East, "and enter into the two Indies, which are the stores of the world. "When once there, we can do without the gold of England."

Majesty's Eastern possessions, and at a rate not exceeding that which will be paid for the conveyance of troops belonging to the Ottoman Empire, and upon such other conditions and regulations as shall be settled and agreed upon by a convention between the English Government and the Sublime Porte.

6. The transport, free of any charge, at all times by the railway of all English mails to and from this country, and any of Her Majesty's Eastern possessions.

7. Until the extinction of the loan by repayment of the principal and interest, the English Government, and the bondholders as represented by the committee, to have an absolute mortgage upon the railway, and land, and works.—(*Vide Report of Select Committee of the House of Commons, dated the* 22*nd July*, 1872.)

* To Persia also, as well as Turkey, the opening up of the Euphrates route would be of the highest importance, as it would give her access to a port on the Mediterranean, and would thus relieve her from the predominating influence of Russia, to which her isolated position renders her specially liable, the Black Sea being at present almost the sole channel of her commercial intercourse with Europe.—W. P. A.

How methodically and steadily, if slowly, the task enjoined upon his successors by Peter the Great has been pursued, let history attest.

The old southern boundary of Russia in Central Asia extended from the Ural, north of the Caspian, by Orenburg and Orsk, to the old Mongolian city of Semipolatinsk, and was guarded by a cordon of Cossack outposts. In 1716, Peter the Great sent a force commanded by Prince Bekovich, to take possession of part of the eastern shore of the Caspian. Three forts were then built, though subsequently abandoned, after an unsuccessful expedition against the Khivans. More recently, since 1834, Russia has succeeded in firmly establishing herself on the eastern shore of the Caspian, where she has now four permanent posts, Fort Alexandrovsk, Krasnovodsk, at the mouth of the Balkan Gulf, Chikishlar, at the mouth of the Atreck, and the Island of Ashurada. To the east she has crossed the Kirghis Steppe and established herself on the Sir Daria or Jaxartes, which Admiral Boutakoff is said to have navigated for 1,000 miles in 1863. Thus the Russian frontier in Central Asia has been pushed forward until her advanced posts on the east look down from the Tian Shan range upon the plains of Chinese Turkestan. In Western Turkestan also, she has gradually extended her boundary, and has annexed or subjected Tashkend, Kokand, Khojend, Samarcand, and Bokhara. In thus pursuing her career of annexation, Russia but follows the natural policy of a great military empire, being forced moreover, as Sir John Malcolm said, by an impelling power which civilization cannot resist when in contact with barbarism. Assuming as there is every reason to do, that the Khivan Expedition will be successful, and that Khiva will be subjugated, it is highly improbable that Russia, whatever be her present intention, will be able again to evacuate the country. To do so would be looked upon as a defeat and would compromise her prestige in Central Asia. She may indeed stop short of absolute annexation, but there can be little doubt that she will at least bring Khiva under the same yoke as Bokhara, and she will thus establish her influence on the Oxus, as she has already established it on the Jaxartes. The Oxus, or Amu Daria, is a noble river, not easy of navigation, but, it is believed, capable of being made so. It will furnish a ready means of carrying the tide of Russian annexation eastward until it finds a barrier in the Hindoo Koosh. When Russia shall have established herself along the Oxus, her position will be at once menacing to Persia and India. From Chardjuy on the Oxus there is a road to Merv, distant about 150 miles, and from Merv a direct road runs along the Valley of the Murghab to Herat, the "key of India." Merv is historically a part of the Persian Empire, but in these countries it is notoriously difficult to define boundaries with any precision. Should Russia succeed in occupying Merv, as there is too much reason to fear she ultimately will, and in converting the neighbouring tribes into friends or allies, her position would be one which we could not regard without the gravest apprehension.

Surely in the face of such facts as these, the time has arrived when England should rouse herself from the apathy of the past, and take steps to secure the incalculable advantages which would accrue to her-

self and her Eastern dependencies from the opening up of the Euphrates route.

The military and political value of the Euphrates line is a matter of extreme moment, and has a far more decided bearing on the defence, not only of Turkey but of Persia and the whole district lying between the Mediterranean, the Caspian, and the Indian Ocean than might at first be supposed.

So long ago as 1858, Field-Marshal Lieutenant Baron Kuhn von Kuhnenfeld, Austrian War Minister, predicted that Russia would in future probably try to satisfy her craving for an open seaboard by operating through Asia.

" She will not," says this distinguished authority, "reach the shores of " the Persian Gulf in one stride, or by means of one great war. But " taking advantage of continental complications, when the attention and " energy of European States are engaged in contests more nearly con- " cerning them, she will endeavour to reach the Persian Gulf step by " step, by annexing separate districts of Armenia, by operating against " Khiva and Bokhara, and by seizing Persian provinces. * * * *

" The most important lines which Russia must keep in view for " these great conquests are,

" 1. The line from Kars to the Valley of the Euphrates and Meso- " potamia.

" 2. That from Erivan by Lake Van to Mossul in the Valley of the " Tigris, to Mesopotamia and thence, after junction with the first line, " to Bagdad.

" 3. That from Tabreez to Schuster in the Valley of the Kercha, " where it joins.

" 4. The road leading from Teheran by Ispahan to Schuster and " thence to the Persian Gulf. * * * *

" Once in possession of the Euphrates, the road to the Mediterranean, " *viâ* Aleppo and Antioch, and to the conquest to Asia Minor and Syria " is but short.

" It is clear that all these lines are intersected by the line of the " Euphrates, which, running in an oblique direction from the head of " the gulf north of Antioch to the Persian Gulf, passes along the " diagonal of a great quadrilateral which has its two western corners on " the Mediterranean, its two eastern on the Caspian and Persian Seas, " and so takes all Russian lines of advance in flank.

" From this it is evident that the secure possession of the Euphrates " line is decisive as regards the ownership of all land lying within the " quadrilateral. It must therefore be the political and strategic task of " Russia to get the Euphrates line into her hands, and that of her " enemies to prevent her doing so at any cost.

" The great importance of a railway along this decisive line which " connects Antioch with the Persian Gulf follows as a matter of course. " It is the only means by which it would be possible to concentrate, at " any moment, on the Euphrates or in the northern portion of Meso- " potamia, a force sufficiently strong to operate on the flanks of the " Russian line of advance and stop any forward movement. * * *

" It is true that, at first, the aggressive policy of Russia in the East

" will only threaten the kingdoms of Turkey and Persia, but as neither " one nor the other, nor both combined, would be strong enough, with- " out assistance, to meet the danger successfully, England must do so ; " and it is certain that she must, sooner or later, become engaged in a " fierce contest for supremacy with Russia. * * * *

" The Euphrates Valley Railway becomes therefore a factor of in- " estimable importance in the problem of this great contest. Even now " the construction of the line will counteract the Asiatic policy of " Russia, for it will strengthen the influence of England in Central " Asia and weaken that of Russia. * * * *

" The growth of Russia in the East threatens, though indirectly, the " whole of Europe, as well as the States named above, for if she were " firmly established in Asia Minor the real apple of discord, Constanti- " nople, would be in imminent danger, all the commerce of the " Mediterranean would fall into her hands, and she would command " the canal through the Isthmus of Suez.

" Whatever the commercial value of the Suez Canal to Central " Europe, there is no doubt that it is secondary in importance to the " Euphrates Railway, which affords the only means of stemming " Russian advances in Central Asia, and which directly covers the " Suez Canal."

Yet the establishment of this route has been pressed for twenty years in vain on the attention of the Government of this country; and even the high recommendation of the Select Committee of the House of Commons has failed to awaken the Government to a sense of the gravity of the issues involved.

The subject, important as it is in its bearing on the power and stability of the whole British Empire, is one of absolutely vital moment to India ; but it should not be forgotten that all our Eastern possessions would participate in the benefits which would accrue from the establishment of the Euphrates route. To take, for example, the case of the Australian colonies—the trade of Australia, which is even now in its infancy, employs between 500,000 and 600,000 tons of shipping annually, and the number of passengers that have left Great Britain for the Australian and New Zealand colonies during the last fifteen years has exceeded an average of 25,000 per annum. The acceleration of the journey which would ensue on the opening of the Euphrates route, could not fail to result in a great increase of the traffic, while new markets would at the same time be opened up to receive the fast increasing produce of these colonies.

There is ample reason to believe that the proposed undertaking would prove remunerative at no distant date; at the same time the results sought are far more important than those which are usually looked for in a pecuniary investment. Why should not we regard the Euphrates Railway as the French have regarded the Suez Canal? In the words of a recent writer, " Nations may receive much larger " returns for judicious outlay than any to be commonly looked for by " shareholders; for the results in material prosperity to be derived by " a community from augmented facility of communication, from moral " and political progress, and above all from an increased security for

"peace, far transcend in value any conceivable amount of dividends, "and should be taken into account in determining as to the propriety "of lending governmental assistance in particular instances."

The general features of the projected Euphrates Valley Railway may be thus briefly summed up:—

It would connect the Mediterranean with the head of the Persian Gulf, between which and Kurrachee and Bombay regular communication is now maintained by a line of powerful steamers, subsidised by the Indian Government.

Making Kurrachee the European port of India in place of Bombay, it would save about 1,000 miles in the distance between England and India, and would reduce the time occupied in the journey by several days.

It would render it possible to maintain India with a smaller European garrison than is now necessary, and would thus reduce our military expenditure.

It would save the Government large sums in sudden emergencies by the facilities it would afford—and that at all seasons of the year—for the transport of troops and stores.

It would enable troops from England to be landed at Kurrachee in about 14 days, and in 2 or 3 days more at Lahore, Peshawur or Delhi, when the Indus Valley Railway system is complete.

It would subject an enemy advancing towards the north-western frontier of India to easy attack in the flank and rear, and would render the invasion of India all but impossible.

It would render the resources of England so promptly available in the East that Chatham and Portsmouth might be made the bases of operations almost as easily as Kurrachee and Bombay; and any hostile movement directed against us, whether from within or without our Indian frontier, might thus be effectually checked before it could assume formidable proportions.

Similarly, it would give our extensive military establishments in India a direct influence in support of our power and prestige in Europe.

It would give England the first strategical position in the world.

It would relieve Persia from the predominating influence of Russia, by giving her access to a port on the Mediterranean.

The railway would be easily defensible by England; both of its termini being on the open sea.

It would be protected by two formidable rivers, the Euphrates and Tigris, on the flank most likely to be assailed.

The length of the railway, from Alexandretta, on the Mediterranean, to Grain, on the Persian Gulf, would be about 920 miles.

The country is admirably adapted for the construction of a railway, and the cost of the line is estimated by competent engineers at from £8,000 to £10,000 per mile.

The capital which would be required would thus be under 10 millions.

Of all the lessons which recent wars have taught us, none is more emphatic than this, that henceforth the power of nations must be upheld by the knowledge and use of mechanical appliances. Among the most important of these are railways, as we saw in the Franco-

German war. A vague presentiment of this marvellous revolution had long existed, but it had to struggle against apathy and deep-seated prejudice. The true secret of national supremacy has, however, now been brought home with irresistible force to the most reluctant mind; and we must brace ourselves anew for a more determined progress, if we would retain the prestige and influence we have hitherto enjoyed as a great nation.

In the Crimean war we saw, with certainty, where the power of the Czar first gave way. The telegraph and rail were the missing links in his armour. He had built fortresses of colossal magnitude, collected resources astonishing from their variety and abundance; his generals were selected with consummate skill, while over the persons and property of his subjects he exercised unlimited control. But all these were as nought to the Czar in his extremity; and the giant aggressor was, by a handful of invaders, with telegraph and steam in connection with the bases of their operations, defeated and humiliated on the soil of holy Russia herself.

We all know how alive Russia has since become to the necessity of following up her advances by improved means of communication. It is inconceivable that any power but England, having either means or credit at command, would hesitate how to act under such circumstances as those in which we are placed. To us it has been a continual reproach that we are never ready for the emergencies which we might readily have foreseen. Let us not refuse, therefore, to learn wisdom by the experience of the past, or some day we shall assuredly be called on to spend untold treasure to retrieve disasters which a little timely forethought would have enabled us to avert.

Captain Tyler: As a fitting supplement to the paper I will also read a letter written by Sir Arthur Cotton to Mr. Andrew on the subject of this proposed railway.

Extract from a Letter from Lieutenant-General Sir Arthur Cotton to Mr. Andrew, dated 20th May.

After expressing his regret at being unable to attend on this occasion, Sir Arthur Cotton goes on to say:—

"Having seen the country between the Mediterranean and the Gulf, I should like to give you my leading thoughts on it.

"I was perfectly astonished at the tone of the debate on it in the House of Com- " mons lately. I could not have supposed it possible that such a debate could have " occurred in our time. For instance, somebody spoke of the smallness of the traffic " on the line of the Euphrates as an objection to it. First, what in the world has this " to do with the matter? Was the Suez Canal decided upon for the traffic on its " banks, or even on the shores of the Red Sea? We are proposing a work to con- " nect the hundreds of millions of India and even of China with the hundreds of " millions of Europe and America, and that question is to be decided by what takes " place among the handful of people in the Valley of the Euphrates! But, secondly, " what has the present traffic even on that line, where it is impossible any traffic " worth mentioning can exist for want of communications and security, to do with " that which those things will create? Are we now to learn that traffic is produced " by communications? Was the passenger traffic between London and Greenwich, " before there was a railway or a steamboat, the basis of calculation for the profits of " those means of transport? For one passenger then, there are certainly 100 now, " more likely 500.

"Is it not wonderful that that debate could have touched upon such points as "this, the present traffic between Bagdad and Aleppo?

"I consider this work as one of the very first national works in importance now "remaining. We have obtained a complete and effective communication for the "great mass of Indo-European traffic by bringing these countries within steaming "distance by the cheapest of all communications, ocean transit. The grand "thing is to establish the quickest possible transit for passengers and goods of high "value, and further, an alternative route, that in a matter of such incalculable im-"portance as the connection of the two parts of the British Empire, we may not be "absolutely dependent upon one line with all its complications of foreign soil, &c.

"If England paid down 20 millions for the railway from the Mediterranean to the "Gulf, it would be an insignificant sum compared with the immense interests involved "in it.

"With respect to the line itself, it is certainly the easiest line in the world. I "have travelled along hundreds of miles of it, literally as flat as a table, with firm "soil, no mud, no waterway; where the rails might be laid on the natural ground.

. . . .

"The first point I would urge is that the immense traffic between India and "Europe should not be made subservient to the local traffic. . . . .

"I hear that population is rapidly pouring into Palestine, and the vast city of "Beyrout, now, it is said, containing 100,000 inhabitants, is an indication of this.

"Thus the points I think to be kept in view are these:—

"That now the quickest route to India is the grand object.

"An alternative route with the Red Sea.

"That it is impossible to calculate what the passenger and valuable goods traffic "may become on such a route, connecting such enormous populations.

"That it is the easiest line in the world for a railway.

"That for England to grudge even a very large annual payment, if it were "necessary, in a work of such immeasurable national importance, should not be "thought of.

"That an amply paying traffic would most certainly be created by such a work in "a very short time.

"Most heartily wishing you success in this great undertaking,

"Believe me,

"Yours sincerely,

(Signed) "A. COTTON."

In a letter from Alexandretta, 24th April, 1873, from Mr. Franck, Her Majesty's Vice-Consul at Alexandretta, to Mr. Andrew, he states "that the sanitary condition "has been greatly improved, that the population is increasing rapidly, that houses "of a superior class are being built, besides numerous places of worship, that the "commerce of the port is rapidly increasing, and that improved means of communi-"cation with the interior are urgently required."

I may add that some years ago I was deputed by the British Government to examine the railways and ports of Italy with regard to the possible improvement of the means of communication with India, and in a report which I addressed to the Postmaster-General in 1866, I made these observations, which, being apposite to the present subject, I may perhaps be allowed to read to the meeting:—

"As I have intimated at the commencement of this report, the question to be "now solved is solely that of communication through Europe to the east of the "Mediterranean. But in saying so much concerning the postal routes to the East, I "would ask your Grace's permission to touch also upon the still more important "saving of time and distance that may be obtained hereafter by avoiding the passage "of the Red Sea, when a railway shall be constructed from the coast of the Medi-"terranean along the Euphrates Valley to the Persian Gulf. By this route many "hundred miles of distance and many days of time might be saved between London "and Bombay, which will become within the next two years (when the railways to "Madras and Calcutta are completed) the principal port of India. The navigation "by the Persian Gulf to Bombay will be far preferable to that *viâ* Suez and the Red "Sea to Bombay, and even that amount of navigation may ultimately be avoided by

" the connection together of Bagdad and Bombay by railway. In the meantime, " the Euphrates Valley scheme has been for many years almost in abeyance. The " mere guarantee of the Turkish Government has not been found sufficient even to " render the construction of the first portion from the coast to Aleppo practicable, " and the financial state of that empire renders progress now all but impossible. " But I have so strong a conviction of the important bearing that the construction " of such a railway would have, commercially and strategically, upon the British " Empire, that I could not but take this opportunity of recommending the subject " to the serious consideration of Her Majesty's Government."

I have also, and more particularly for the Parliamentary Committee of last year and the year before, upon this subject, very carefully computed the distance and the time that might be saved by adopting the Euphrates Valley line. I found, comparing the Suez route with the Euphrates Valley route, that the saving in time would be 92 hours by the Euphrates Valley route over the route by Suez to Bombay, and 130 hours as between the Euphrates Valley route to Kurrachee and the Suez route to Kurrachee. The saving in distance as between the two routes would be 723 miles to Bombay and 1,170 miles to Kurrachee. The cost of the Euphrates Valley line has been fairly estimated, I think, at about £9,000,000 of money, and the length of railway to be constructed from Alexandretta to the Persian Gulf would be about 900 miles. It may seem, and does seem to some persons a great deal of money to spend—£9,000,000 of money—in order to save the time and distance that I have stated. But that feeling will be found to diminish when this case is compared with other cases. For instance, let us consider what is being done, and has been done in America. Look at the railway across that continent from the Atlantic to the Pacific—1,700 miles long, from Omaha to San Francisco—over a great proportion of desert country more or less impassable in winter from the snow, and a great part of which will never be populated. Yet the Americans did not think so very much of making such a line, 1,700 miles long, with San Francisco at the one end of it and the settled States of the Union at the other end. Then there is the Intercolonial Railway in Canada. The Canadians have made a line at their own expense 400 miles long, for the purpose of connecting the Lower Provinces, New Brunswick and Nova Scotia, with the rest of the Dominion of Canada. And not only have they made these 400 miles over what is for the most part an unpopulated country, but they are also contemplating a line of 1,000 miles from Lake Nipissing to Fort Garry, over the sterile country to and round the north of Lake Superior; but further than that, they have also undertaken, as a part of the arrangement under which British Columbia joined the Canadian Dominion, to construct 1,600 miles of railway from Fort Garry to the Pacific. In looking at the magnitude of these operations, the comparatively small results to be obtained, and the difficulties connected with the working of such lines, it does not seem so very much to contemplate the making of a railway for a distance of 900 miles from the Mediterranean down the Euphrates Valley at a cost of £9,000,000. In that case we should look for a traffic not merely of pilgrims and coffins, which, according to one of our leading statesmen, in the recent debate in the House of Commons, was all that could be expected; we should not even care seriously for the local traffic which would ultimately be developed; but we should make provision for the through traffic between India, with 200,000,000 of inhabitants, and its rich productions, on the east, and the whole of Europe on the west. Then, again, the Russian Government has been wisely collecting British money from time to time for making long lines of railways through its vast territories, and is very fast completing and projecting lines of railway which will complete the communication of St. Petersburgh and Moscow with the country of the Caucasus, with the Caspian, and with the frontiers of Persia. And we all know that the Shah of Persia is about to visit this country with those who have undertaken to provide him with money for railways down to the Persian Gulf. Inasmuch as British money is materially assisting in the construction of railways which may hereafter become useful for hostile operations against the British Empire, it seems, again, not very unreasonable to advocate the construction of a railway of counteracting influence between the Mediterranean and the Persian Gulf which would be of supreme importance to us, as has been ably explained in Mr. Andrew's paper, commercially, politically, and strategically.

Captain Felix Jones, F.R.G.S.: My Lord, ladies, and gentlemen: I rise with some diffidence to take part in this discussion. Although I have been long resident in the countries under notice, and in Mesopotamia in particular, still I should not have come here to-day, were it not that I read the debate on this subject in the British Parliament, which, I must say, surprised me exceedingly. We there learnt that this country, from time immemorial never had a population, and never would have one; I also read the remarks that Captain Tyler had alluded to—that "pilgrims and coffins" are its only trade, and that a first-class railway carriage per annum would no doubt convey the whole of the first-class passengers on the projected Euphrates Valley line. It was also stated that one goods train yearly would suffice for the goods traffic. Now, having been in these countries for so many years, having traversed them in almost every direction, and being well acquainted with their local features and rivers, I repeat that I never was more surprised in my life at hearing such remarks made in the British Parliament. I could not have believed it if I had been previously told, that people eminent for their learning, would speak in a manner discreditable to a schoolboy. With reference to the populations that have been there, and that may be there *in futuro*, almost every mile of the country indicates the falsity of the descriptions that were given of the country in Parliament by the opponents of this measure on the night in question. The whole face of the country, from Constantinople to the Persian Gulf, and that particular portion from Alexandretta to Grain—in fact all Mesopotamia—is covered with remnants and vestiges of habitations of a former period. It is covered in every direction with lines of canals, just in the same way that a chess-board is covered with squares. A traveller can scarcely go a mile without finding the vestiges of an early civilization, and we have only to visit our own museums to witness the works of a people long established on the soil. Knowing all this, to be told in the British Parliament that the country has never had a settled population is something wonderful indeed. With respect to the trade in "pilgrims and coffins;" perhaps no better commodities for commercial intercourse could have place in that part of the world, for every pilgrim that goes in the direction of the sacred shrines of Najaf and Kerbela, carries from every part of the Mahommedan world, his dead relatives simply to bury them in these sacred localities, and, at the same time, to make a long trading voyage. Braving the perils of the land and the sea for the purpose, and carrying merchandise, he profits, not only devotionally, but commercially. If anything in particular could give commercial value to the route in question, it is the fact, that almost every Mahommedan of the Shiah persuasion in India and Persia, and in countries still more eastward, has his eyes in the direction of these two shrines. Many of them proceed on foot; like the pilgrims, with peas in their shoes; they will bear any risks, endure any hardships in order to get to these localities. If we only provide the means for them, we shall never have to complain of a want of traffic in that direction, for "pilgrims and coffins" will bring profits in abundance. We know what has been the result of the trading voyages to the Persian Gulf of the British India Steam Navigation Company within the last ten years. In 1830 the whole of the British trade came round the Cape of Good Hope to India and from India, it was disseminated with Indian produce by way of the Gulf and Euphrates, throughout all Persia, and up to the very confines of Russia by means of the old East Indiamen. In 1833, the Charter of the East India Company was taken away, and from that time, the fleets of the East India Company ceased to visit that particular locality, and the great caravan routes were closed between the Mediterranean and the Persian Gulf. The consequence was, that in a few months the whole trade that spread itself northwards to the shores of the Caspian and the Black Sea, was put a stop to, and from that time, until 1862, Russian trade began to flow from north to south, and to occupy the position formerly possessed by the British trade. In 1862 the Government of Bombay were induced to take up the question through the enterprise of British merchants, and by way of testing the route again, they granted to the British India Steam Navigation Company a subsidy of a small amount. A small steam-vessel about 600 or 700 tons was first sent from India to the Persian Gulf. Such was the small amount of produce to be got there after that long lapse of time, that this small vessel could scarcely find enough to make half a cargo for the return voyage. The same thing occurred for two or three voyages, and then there was evidently an increase, owing to the merchants keeping

to regular dates. That was in 1862. In 1872, instead of that small ship of 600 tons, returning every six weeks half filled with impressed goods to India, it was contemplated to run vessels weekly. Vessels of upwards of a thousand tons now go and return constantly full, both of cargo and passengers. That, assuredly, is an indication of the great increase of traffic there, and most of that traffic is due to the "pilgrim and coffin" class. With regard to the passengers who would travel between the Persian Gulf and the Mediterranean in such small numbers, that "one first-class carriage would suffice to take them, and one goods train per annum," I should like to have been a Member of the British Parliament for that night, and to have asked the gentleman making that remark whether he had ever been in Egypt before the creation of the Rea Sea route. It happened to be my lot to be in Egypt at that time, and I remember that one donkey would have sufficed to carry the whole traffic of the region; but the fact of one donkey or one first-class carriage sufficing for the whole traffic of the region at this or that day, surely is no indication of what good railway communication will effect? I may draw attention to the locality under notice. Mr. Andrew's paper has very ably described the whole of the tract. In fact, anybody who wishes for information in detail on his particular line may get it pretty well from the evidence given before the Select Committee of the House of Commons, whose favourable report by-the-bye seems to be of no account whatever with the Members! With respect to other railways than that under notice, I would draw attention to the whole of the region from Constantinople, or Scutari, north of Aleppo towards Mosul, and onwards to Ispahan and Herat. That tract is covered by ranges of the most stupendous mountains with no great distances between them, so that they are constantly overlapping the one over the other. To carry railways through that region of Asia Minor to any part of our Indian territories eastward would be perfectly impracticable even if we had more money than we are said to have at our command. I do not say that there are positively insurmountable engineering difficulties there; but there are such engineering difficulties as to be almost insurmountable from the want of money. No amount of capital would suffice to construct and maintain a railway through that country. Then there are the enormous political complications which it would give rise to. The Russian frontier touches on Ararat. You have Turkey immediately on the one hand, local tribes to the eastward, and Persia on the south with all its tribes, and with the other tribes to the east of Persia again. Then, through Herat and Afghanistan to India you would require separate Treaties, and of course where separate Treaties are concerned, there are complications which increase every mile. Any attempts to carry a railway in that direction must be wholly futile—at least in our day. A millenium must take place before such a thing could be perfected so as to carry out speedy intercourse with India; but south of Aleppo, eastward to Mosul, there are no difficulties but what might be surmounted with money and ordinary circumspection. Some people are for taking the railroad from Aleppo eastward by the foot of the mountains trending towards Mosul, and across the Tigris by the eastern banks to Bagdad, and so on east of the Tigris to Bushire and onwards to India by the margin of the Persian Gulf. That, no doubt, is a very feasible plan; it merely requires money; and indeed a portion of the line is, generally speaking, on the track of the ordinary traffic of the day. I would explain that the reason of the ordinary traffic being at the present day in that direction arises simply from the fact that Turkey has become too weak to carry its trade, where, from the very remotest ages, it had its lines of direction from the Mediterranean to the Persian Gulf: it is unable to defend the line of the Euphrates; the consequence has been, that the current of trade has set on the north-eastern parts of the Empire where the rivers are placed between the travellers, the traders, and the Arabs. But by taking the route from Alexandretta by way of Mosul we increase the distance very nearly 300 miles. Now 300 miles of extra distance is a very expensive concern. Again, when we get to the east of the Tigris, if our object is to go to Grain, we have to come back across these rivers after going to Bagdad in a region wholly flooded during most parts of the year, or so far cut up with water that it would endanger our railway communications wherever they might be. Again, in taking the railways from Aleppo to Mosul, the whole tract lies at the foot of a very high range of mountains, rising almost immediately from the Mesopotamian

plains. The consequence is, nearly every mile of the country in that direction is traversed by ravines that have been cut in a southerly direction by the rains and the melting of the snows for ages. The result would be a longer railroad, and every one of these ravines would have to be bridged, and viaducts of an enormous extent would have to be made. Taking the railway in that direction, even to Bagdad, would be so very expensive as almost to neutralize its utility. Then, having got as far as Bagdad, we enter at once upon the marshy tracts—tracts broken up by the inundations issuing from the very high mountain ranges of Persia on the eastward, and from the Euphrates and Tigris themselves having broken their embankments farther north, and overspreading the whole country from Hillah, due east. South of this line must be understood to be the true basin of the Euphrates and the Tigris rivers. There, at the period of the melting of the snows on the Armenian and Persian mountains, the waters spread occasionally as far as the Persian mountains; to carry a railway across Mesopotamia and through these marshes would, therefore, entail not only an unnecessary expense but would necessitate constant repairs at an expense too enormous for any engineers to think of. Within a few inches of the surface of the soil, water is always to be obtained; and, I believe, all engineers will agree that a place where water can be got so readily is not a place for viaducts; for their foundations must lie at a depth of 16 or 18 feet to be secure in this part. I, therefore, look upon the route of the Tigris—especially on the western bank—as not to be thought of.

The question of intercourse with India resolves itself simply into a financial question. I maintain that the direct route is the best, and financially the safest to enter upon. That route is undoubtedly from Iskanderoon by the Euphrates to Grain on the Persian Gulf. Here the earliest capitals stood. It is the old route of trade from the remotest period. The traffic between India and all the Western World, has from ancient times, followed this line of direction. The Mahommedans, when they first overran the country from Arabia, settled in these districts; and it was only when they extended their conquests farther eastward into Persia, that they made Bagdad the capital, and for more reasons than one. As the Caliphs became weak, they liked the Euphrates between themselves, and their kindred Arabs; for Arabs are no respecters of persons: they will eat each other up just as readily as they will prey upon the general community. Here, then, they could be utilized. Therefore, I look upon the city of Bagdad as it at present stands, as more a city created by weakness than by strength; and if it were our purpose even to aid the Turkish Government in railway intercourse through its dominions in this direction, I maintain that the two holy shrines of Najaf and Kerbela, which you see on the route, and the other towns that are in existence there, would become of great local importance, and would strengthen her dominions throughout, besides giving us an alternative way to the East, and a very fair return for our money. I do not mean to say immediately, but in a few years. Then, again, if we wish to make Mesopotamia a country, as it is stated to have been of old—the granary of the world—we must give peace to Mesopotamia; and Mesopotamia never can have peace unless we draw the line of railway in the direction that Mr. Andrew has pointed out. By that means we should have a barrier against the Arabs, and peace within the fertile region of the rivers, so as to admit of colonists pursuing their operations in quietude. I find that I have exceeded my time, but really the subject is so large, that one does not know where to stop. Let me add that the perfection of Great Britain's duties to British India lies now in the direction pointed out.

Lieutenant-General Sir ARTHUR T. CUNYNGHAME: Having been requested to say a few words upon an overland route to India, the only claim which I can show to a knowledge of this subject is that of having commanded the division of the Army of Bombay in Kurrachee under his Lordship our President, and of having travelled latterly through a large and interesting portion of the northern countries shown on the map.

I allude especially to the Sea of Azof, the rivers Don and Volga, the Caspian Sea, and, generally, by Tiflis, Mount Ararat, and the confines of Persia and of Turkey.

The question, I conceive, now before us is, what is the most advantageous route

for a direct railway line from England to India, and one that would be a really overland one.

Now if we look at the map we should say that the nearest route would be by Constantinople and Scutari, then passing to the north of Ararat by Erivan, thence near Teheran towards Herat, from thence *viâ* Candahar to Mooltan, thus entering India directly from the west.

The alternative route to be considered is that from Constantinople to Aleppo, thence to Bagdad and Grain, thence by the south of Persia, Shiraz, Bunder Abbas, and Beloochistan to Kurrachee.

Now let us briefly consider the advantages and disadvantages of these two systems.

First, let us look at the northern one. I think it must be conceded that this is the most direct. But the disadvantages are manifest. Before any portion of this route could be available, nearly the entire distance must be compl ted, and its length would be open to possible trouble and future complications. When I was in the Government of the Caucasus, between the Caspian and the Black Seas, I then learned that it was the intention of the Russians almost immediately to connect the northern lines from Taganrog by Stravapol and Deobend with Bakou her new naval arsenal on the Caspian, and then to prolong this line towards Persia, and so to Teheran. Now when we look upon the enormous forces which Russia has at her command, and the facilities for transporting them—at least 150,000 men in the Caucasus alone, in addition to troops in the interior, on the Don and the Volga—it will at once be seen how rash it would be for us to expose our long thin line of communication to such chances, putting even out of the question such difficulties as we should meet with in consequence of its running through nationalities very slightly civilized and under different rulers; indeed, when I was near Bakou, it was reported that Astrabad was surrounded by wild hordes of Kurds, so that the Persians were not able to enter their own city.

Taking, therefore, all these circumstances into consideration, as well as the distance and the expense, I cannot hold the idea that our overland communication with India should be made—more especially with English gold—by the line of the north of Persia.

Being of this opinion I desire to examine the next proposition.

Now presupposing that we arrive at Constantinople by rail, which we very soon shall do, let us consider a line from thence to Aleppo, and Bagdad, and Grain, then branching from Bagdad to Shiraz and Bunder Abbas, and then by Beloochistan to Kurrachee. When completed this line would equally take us into India without a mile of sea.

One of the greatest advantages of this line would be that a large portion of it would be available for traffic before the whole was completed. I allude to Aleppo, to Bagdad, and Grain, the connecting link from Aleppo to the Gulf of Scandaroon being made.

This centre portion, it is stated upon excellent authority, is about 900 miles long, and would cost about nine millions to complete. The remaining portions, to obliterate all sea traffic, would probably cost the same sum of money, and would not very much exceed the same distance; and the connecting link from Aleppo to Alexandretta would render this line immediately available for traffic, and would open out communication with Spain, France, and, Italy, and by the Straits of Gibraltar with America.

For the reasons, therefore, I have above adduced, and believing that it is far more advisable if possible to penetrate the lands of one foreign State rather than many, and that of one who has ever proved to be a sincere friend of our own, I believe that this is the best line we could adopt for our overland line to India—one which could be more readily protected by us—and looking into our general political relations and our great interest in India, I am of opinion that no time should be lost before we should mutually draw together—the 150 millions of inhabitants which inhabit our Eastern Empire with ourselves—and that a first outlay of nine millions of money is by no means excessive towards obtaining so desirable an object.

Colonel Sir Arnold Kemball: My Lord, I believe the discussion on this subject would not be complete without some advocacy of the line which has been condemned

by Captain Jones—that, namely, from Aleppo *viâ* Mosul, and so down through Bagdad to Grain—Grain would still be the terminus of this line, which, I think, there can be no doubt, commercially, would be superior to that proposed by the direct route from Aleppo down the right bank of the Euphrates. Whatever may have been the state of the country in very ancient times, it is the fact now that the line in question would border an absolute and irreclaimable desert which it would be impossible to cultivate; also, that at the present time, over a great portion of its course, you would have to create a population, and consequently, a trade. As you get lower down you meet with more settled inhabitants, but they are excessively poor, and the products of the country are inconsiderable. It yields nothing that could support an internal traffic to the railway, and even the rice grown there is scarcely sufficient for the demands of the population of the province. It affords nothing for export until you get to Bassorah, whence dates are available. Therefore, that line for at least a very considerable period must depend for its income upon the through traffic between Europe and India. Again, referring to the greater facilities afforded, whether for the transport of troops or for commerce, by the Suez Canal, or even by the short railway through Egypt, no merchant would undertake the risks and delays of transit consequent upon having to land his goods, in the first place, at Alexandretta, and to re-ship them at Grain, with a thousand miles of rail to be traversed in the interval, while by the Suez Canal he could convey his cargo, without breaking bulk, from Europe to India. As regards the saving in time, though no doubt a considerable saving would be effected in actual distance in favour of the Persian Gulf route, viz., 700 miles to Kurrachee, and 1,100 miles to Bombay; on the other hand, we must not overlook the amount of time that would be lost, to say nothing of the risk incurred, more especially in the transport of troops over 1,000 miles of country. Surely to convey them in carriages from the terminus on the Mediterranean to the terminus at Grain, with all their stores and equipments, would involve a certain loss of time, fully counterbalancing the gain in distance. The fact is, I think, that neither of the two lines referred to, that is to say, the line by the Euphrates Valley and the line by what we should now call the Tigris Valley, can ever come into competition with the route *viâ* Egypt. These must be considered in contrast with each other, on their own merits exclusively. It is perfectly true that, in point of distance, the difference in favour of the former would be, say, 250 miles, and in respect to the latter, also, the cost of maintenance would be considerably enhanced,* but the longer route has this advantage—that it would run through the populous districts of the country where a traffic actually exists. As Captain Jones observes, a traffic has been developed by the line of steamers established between Bombay and Bassorah, but every portion of that traffic is derived from the Tigris,—not a particle of it, I believe, from the Euphrates. The reasons are obvious. Not only has the line of the Tigris the advantage of a considerable local traffic, but over it must pass, as far north as the latitude of Diarbekir, all the trade of the western provinces of Persia, on its way to either sea. The Euphrates line, on the other hand, would border an irreclaimable desert, without a single feeder of any kind. Moreover, during construction, we might calculate upon each section of the Tigris line, when completed, contributing to pay its own expenses. Holding these views, I have thought it only right to contrast the merits of the two lines. Very eminent men have been mentioned as supporting the one, but the other also has its advocates, and among them I may mention one of acknowledged eminence, namely, Sir Henry Rawlinson, who has had no hesitation in giving the preference to the Tigris route.

Captain the Hon. Randolph Stewart: My Lord, Ladies, and Gentlemen, the reason why I address you is that, although I have not had the advantage of living in these particular countries, I have been many years in India and other parts of the East, and have spent a good deal of time, and considerably too much money, at Constantinople, about this very question. I think that the discussion, this afternoon, has wandered away from the main point. We

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* The adoption of the Tigris Valley route would necessitate the construction of two bridges over the Euphrates; but to connect the Euphrates Valley line, if adopted, with Bagdad or Mosul, it would equally be necessary to bridge that river.

met here to discuss the Euphrates Valley Railway, with reference to the Central Asian question. I do not think that, in the paper we have heard read on behalf of Mr. Andrew, and, with very few exceptions, in the words of the subsequent speakers, that any practical reference has been made to the Central Asian question whatever. I maintain that this Euphrates Valley Railway project has less to do with the Central Asian question than any other scheme of railway you can devise in that direction. We have heard a good deal about "lofty ambition in talking about "railways from Constantinople and through-railways by Persia towards India." Now, I admit I am one of those who hold that lofty ambition, and I am in good company, for Sir Donald Stephenson, who was the pioneer of railroads in the East, has all his life advocated a railway starting from Constantinople, and passing *viâ* Persia in that direction, and he still holds the same views. Then we come to the question of the Euphrates Valley proposal itself, and we have been told that this railway is necessary, and that it must be carried out. I maintain that the Euphrates Valley Railway Company, as it has been called, has been the bugbear to all improved communication with the East. Some 16 or 20 years ago there was a company—their concession has long ago lapsed, and that company does not now exist—but those who promoted it still keep its name up and its memory alive in a window in the City, and, whenever an attempt has been made to carry out through-transit with India, the original promoters of this line have stood in the way, and have prevented what might have been realized from ever coming to a head. One reason that I may mention against the Euphrates Railway scheme is this, that, when I was at Constantinople, I was intimate with the Ministers of that day, with Aali Pacha and Fuad Pacha, both of whom declared to me most solemnly, that they would give no concession whatever for any railway through Asia Minor that did not take its start from Scutari. Now, the Turks have a right to be heard in this matter. Of course they may have changed their opinion since that time, but we have nothing before us to show that they have. They were offered very good terms indeed by the parties with whom I co-operated, and I doubt whether they would give a concession now, with guarantee or subsidy, unless the line started from Scutari. At that time there was an idea of connecting the projected Asia Minor Railway, of which I was one of the concessionaires, with the European lines which were being made, and for which concessions also had been given, down from Belgrade southward; and a distinguished German engineer, Herr Ruppert, drew out plans, by which he showed it was possible to bridge even the Bosphorus. Now, if this were carried out, and the railway was brought down from Ismid to Kutaya, Konia, and Kaisaria, we get to the Taurus range. Of course it is very difficult to cross the great chain of the Taurus, but I do not think, in this age of the triumphs of engineering, we need imagine there is any mountain range which an engineer cannot either pass over or cut through. Where the Taurus range finishes towards the north-east, the spurs of the mountains become much lower, and, if a line were to go from Kaisaria some distance north-easterly from Aleppo, south of Ararat, and down the Tigris by Mosul—the ancient Nineveh—to Bagdad, it would not only travel through a most fertile part of the country, but it would have this advantage to its shareholders—that the Turks themselves are extremely anxious to be put into communication with Bagdad. Bagdad is the richest of their provinces and, when they send a Pacha there to administer their revenues, they get precious little in return from him. He makes himself rich, but the State gets no good from it. They are therefore extremely anxious to be put into rapid and easy communication with Bagdad, and would probably be most willing to further a line by this route. It was said in the paper read, that the two termini of the Euphrates Valley Railway, being upon the open sea, might be protected by our fleet; but, unless Sir William Palliser can invent us a gun carrying 900 miles, I do not see how that is to prevent incursions of Arabs in the centre of the line. It runs through a perfectly barren country part of the way, and they are in terror, even now, of the Arabs, in those parts. How then are your working parties to work without protection from these marauders? The Turks are not able to give it, and the moment we land a European soldier, for either offensive or defensive purposes, in that country, we open up an international question, which, I doubt whether Russia would allow us to decide in the way we should wish. Further, I think I am right in stating that troops never travel more than 200 miles

a day by railway; and, as this is a distance of 900 miles, they cannot go that distance all at once, but will have to halt more than once on the journey (see foot note). With reference to merchandize, I am convinced that merchants would not be willing to break bulk at Alexandretta and the mouth of the Persian Gulf as well, for the sake of a saving of a few hours' time; and I am also of opinion that the advantage gained by not having to disembark troops, to re-embark them, and to halt them from time to time on the road, will greatly counterbalance the very short extra time taken up by going through the Suez Canal. There is one other point I must allude to, which was the statement that steamers could attack the flanks of troops moving through Persia, along the head of the Persian Gulf. It is almost too absurd to be adverted to, but it was one of the arguments made use of, that, if we had this line of communication to Kurrachee, steamers could protect or annoy troops advancing round the head of the Persian Gulf. We know perfectly well they have just to move a little way inland, and all the steamers in the world could not have any influence upon them. I think, before I sit down, I ought to sum up what I feel on this subject, in these words: that, until we can satisfactorily state what is really not only the most economical—I do not mean the cheapest, for that is not always the most economical—but what will ultimately prove the most economical, and the most strategic line, and at the same time the line with the greatest probability of permanence and commercial success, it would not be advisable for our Government to support this scheme. I had some conversation, five years ago, with the then Secretary of State for Foreign Affairs, the present Lord Derby, about an enterprise, of which this scheme was part of the subject, and he told me it was impossible that the then Government could submit such a project for parliamentary support, and I ask you whether, considering the composition of the present Parliament, it is more likely to help the plan than the last?

Captain WILSON, R.E.: I should like to say a few words on the great military importance of this railway. We may look at it from three points of view: First. as an alternative route to India. I do not think we can have too many strings to our bow, and the Euphrates Valley Railway would give us an additional line of communication with India. We have, at present, two lines—that by the Suez Canal and that by the railway through Egypt. Either or both of these might be closed to us, by local complications or by a combination between Egypt and one of the Great Powers, with a view of obtaining her independence. It does not seem generally known that the canal can be closed with great ease, either by sinking a ship in the channel, or by blowing in the sides at two or three points where the banks offer peculiar facilities for hasty demolition. It has been said that we could keep the canal and railway open by having a ship at each end of the canal, but if there were local complications in Egypt, I do not see how two ships, one at either end of the canal, could keep it open; it would not prevent a ship being sunk in the channel, nor would it prevent the sides being blown in; and unless we are prepared for a military occupation of Egypt, we should have to depend on the old route round the Cape. The Euphrates Valley Railway would, of course, be also liable to interruption from local disturbances, but I think the tendency of the evidence given before the Commission is to the effect that little interference is to be expected from the

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NOTE.—My remarks about the movements of troops at a rate of not more than 200 miles a day were, of course, intended to refer only to the ordinary reliefs, and that I am probably better aware than Sir G. Jenkinson, from having had much personal experience, that, in times of emergency, troops can make forced marches by rail as well as by road; but I also omitted to point out that the rolling stock on the projected Euphrates Valley line could never be sufficient to meet the sudden requirements which warfare in India would demand. It is necessary to point out that the best modern military authorities require 72 trains, of from 24 to 30 carriages each, to transport 20,000 infantry, 2,000 cavalry, 8 batteries with the necessary ambulance, ammunition, &c.—a smaller force than that despatched to India in the mutiny, and that intervals must be allowed between the despatch of each train. I ask any impartial reader what would become of this force on the Euphrates Valley Railway, if it were made, and how long it would take to get to Kurrachee?—R. S.

Arab tribes along the course of the proposed railway. I do not know any one who could give better information on this subject than Captain Felix Jones, and I believe his opinion is, that there would be little or no trouble in making and protecting the railway. Second. The shortest route to India. It is most desirable to obtain the quickest possible means of communicating with India, and if we can only save three days, it would be, under many circumstances, of great importance. For instance, supposing the Indus Railway system completed, and a Russian attack to be made upon India by the route of Herat, Kandahar, and the Bolan Pass, it would be of the greatest importance to save three days in the conveyance of troops from England to Kurrachee, whence they could be thrown upon the line of the Indus to meet any force advancing from Afghanistan. Third. The strategical importance of the railway with reference to Russian movements in Central Asia. Baron Kühn, the Austrian War Minister, in the pamphlet he published in 1858, was one of the first to point out that one of the probable effects of the Crimean War would be to direct Russian attention to the East, and that, having been foiled in Europe, she would endeavour to compensate for it by increased activity in Central Asia. We have seen what rapid progress she has made during the last few years; and Baron Kühn thinks that the movement is, in reality, one directed towards the Persian Gulf. His opinion, in one respect, was recently endorsed by Mr. Disraeli in the House of Commons, namely, that the acquisition of a seaport which can be used at all periods of the year, is a necessity to Russia. At present she has only one seaport, Vladivostok, on the Sea of Japan, which is not closed by ice for several months during the year. In the event of a Russian advance on the Persian Gulf, a railway up the Valley of the Euphrates, would, as the extract from Baron Kühn's pamphlet shows, be of the greatest importance, and I think that the position which has been laid down by Mr. Andrew, and of which Captain Felix Jones approves, is certainly the best, in a military point of view, that could be adopted. Any force advancing on Mesopotamia from the Russian possessions would have to cross the mountains that Captain Felix Jones has just described by extremely difficult passes, and would afterwards have to cross the Tigris and Euphrates before they could reach the railway and interfere with the communications. The time which a Russian force would take to reach the Euphrates from the nearest point of the present Russian boundary, would be from five to seven days more than we should require to convey troops from Bombay or Kurrachee to any point on the railway, so that we should always be able to concentrate a force in the Euphrates Valley in ample time and sufficiently strong to deal with any force advancing from the north. As far as regards the most suitable route for the railway to follow, I think we should endeavour to secure that which would be of the greatest strategical importance, and would afford the greatest facilities for the transport of troops, not that which would be most convenient for the carriage of merchandise and passengers. It is difficult to see how we could transport troops from Scutari to India; for in order to get them to Scutari, we should have to make treaties with every country in Europe through which the line of railway passed; and the difficulties to be expected in Asia Minor have already been mentioned. A failure on the part of any one country to fulfil the stipulations of any such treaty would close the line; whereas, if the line shown on the map be adopted, we should always be able to secure the ports as long as we retained the command of the sea, which I hope we shall never lose. Similar objections of course apply to any railway commencing from the shores of the Black Sea, with the additional one, that it would be of more assistance to Russia than to England.

Sir George Jenkinson, Bart., M.P.: I had no idea of saying anything when I came here to-day, but as his Lordship has asked me to say a few words, I think there are, perhaps, one or two errors which have been stated to-day, which, from my knowledge of the subject, I may be able to correct. In the first place, I must say I entirely concur with the able paper which has been read to us. It contains the very marrow and pith of the whole of the evidence and information which has been brought forward many years ago, and also before the late Select Committee of the House of Commons, and it embodies everything that has ever been said by the pioneers of that line, beginning with the lamented General Chesney, and the most eminent men who have studied the subject. With regard to the upper line through Persia, I heard Sir Henry Rawlinson give his evidence, in which he described that

and other similar routes as simply impracticable, because of insuperable engineering difficulties, and therefore I do not think we need waste any more time in talking of them. His only objection to the line along the Valley of the Euphrates was, that it would cost too much money, and more money than he thought it would be worth the while of England to lay down. That is an opinion in which I, for one, do not at all concur, because I think, for a great country like England—the pioneer of civilization, the nucleus of wealth, and the leader in the van of progress all over the world—to raise such a paltry objection to such a line as the Euphrates line would be, giving us such advantages, morally, and physically, and politically, for our great dominions in the East, I think it is an objection which ought not to weigh for one moment. Assuming the outlay to be ten millions—I believe the line might be made a single line for five millions—assuming, however, the cost to be ten millions, and assuming England to give a mutual guarantee with Turkey for the interest on that sum at four per cent., Turkey has always fulfilled all her engagements; she never failed to fulfil all her pecuniary promises to this country; at this moment, the loan, which was guaranteed by France and England in 1854, is now at the same price as it was when it first started, I believe at about 102. I mention that to show that I do not believe England would incur any pecuniary risk whatever; the interest upon the amount of money would be paid by Turkey, and the advantages which we should gain by the transmission of our men and troops when any emergency arose, would entirely counterbalance any possible pecuniary risk we might undertake. As to the remark made by Captain Stewart, that English troops could not go 900 miles in railway carriages if the safety of India was at stake, why what becomes of the whole history of England? what becomes of all that English troops have ever done —marching great distances in the hottest of suns, and dying, perhaps, by scores? To say that English troops could not go 900 miles if they were required to do so on any emergency, I do not think that is an argument which any Englishman need ever waste time to answer. When we recollect the passage in the Red Sea, which is now fraught with the greatest danger and suffering, I think the troops would be gainers by the transition. But supposing that no troops were taken by that line except in a case of the greatest emergency—and I will on that point allude to the evidence which our noble President and others gave before that Committee, which I do not think Captain Stewart can have read, for he seems to be entirely ignorant of all the great facts brought out with such force upon that Committee—the whole of the evidence went to show that in cool weather the troops would be infinitely gainers by being taken by the Persian Gulf route. And as for the argument, that the line might possibly be attacked by Arabs, what would be easier than to make the various stations small forts. In the first place, the line from Alexandretta to Aleppo would be perfectly free from attack, and taking the whole of the plain, nothing would be easier than to make the various stations small forts. Everybody knows that the Arabs are always amenable to reason, and to be treated with, and that they always faithfully perform their engagements; and even if they do not, why in America they have used the same precaution of making forts along the railways, therefore I think that is an argument not worth treating seriously. But as long as the English Government refuses to assist in a pecuniary manner this line of railway, I am afraid private enterprise will never be able to undertake it. With regard to the wishes of the Turks, I quite admit that their wishes ought to be consulted; but from my own personal knowledge, if we are to attach any importance to the authority of the present Turkish Ambassador in this country, his Excellency Musurus Pacha, he was the first person who put this matter into my head; he always has been a most earnest advocate of the Euphrates line there pointed out, from Alexandretta to Grain; he has always written to me, and told me that the Turkish Government are most anxious for that particular line; that although they would also be glad to get the line from Constantinople to Aleppo, he knows that is entirely a Turkish affair, and if the Turks wish for English assistance, they must construct the line that will best suit England. He has always strenuously advocated that line, and no other; therefore I think there is no difficulty on that score. I had no idea of taking part in this discussion, but if people, taking any interest in these questions, would only read the evidence taken before the House of Commons upon different points, they would see that a great deal of what has been said to-day

is utterly baseless, and that the real point at issue is one of money, and of money only.

Captain TYLER: In thanking the meeting for the kind manner in which they have received this paper, I would add a few words in reply to some of the speakers. With regard to the Suez Canal it is no doubt a most valuable auxiliary to the traffic between Europe and the East, and it is especially useful to us; but, as Captain Wilson has said, the navigation might at any moment be interrupted, or altogether stopped, only too easily, either by means of a little gunpowder for blowing in the sides of the canal, or by sinking a ship or two in it; and in the event of a military emergency, it might thus be quickly rendered useless, and could only be made available again after a considerable lapse of time. It would, indeed, take a much longer time to render it again fit for service than a damaged railway. Then, again, as regards the competition of the canal for traffic, no doubt the canal is, and always will be, as long as it remains efficient, most useful for the transport of goods which it would not pay so well to carry by railway; but in the case of many classes of goods a saving of time is very important; and the railway would be valuable for those descriptions of traffic which it would be worth while to send along it, such as silk, indigo, tea, &c., besides the mails, passengers, and various valuable commodities. As regards the differences between the two routes, the one by the Tigris, and the other by the Euphrates; no doubt, as has been well pointed out by some of the speakers, the longer route—of say, 1,150 miles—by the Tigris, would be in the opinion of those who might wish to make the railway for the sake of obtaining local traffic, or of developing the country, the more important route of the two; but *our* main object in advocating the construction of this railway is to acquire the shortest, quickest, and most efficient means of transport, for military and other purposes, that we can possibly get, with a view to expediting and improving our own communication with the East. Looking at the subject from that point of view, it is not to our interest to guarantee such an amount of money as shall enable the Turks to develop the resources of their country, but only to guarantee such sums of money as are necessary for improving our own communications. And there can be no doubt, I would submit, that the line south of the Euphrates would be more easily defended, and would be attacked with greater difficulty, than any line which would run along the north of it, and, therefore, nearer to the military posts or depôts, now existing or hereafter to be established, of the Russian Government. I think it was Captain Stewart, who advocated going through the Taurus Mountains! Would not that rather be taking the bull by the horns? When we find down the Valley of the Euphrates a smooth flat line, so that you can almost lay the rails on the ground, when we find a line of that sort, to be laid at a minimum of expense, and worked to a maximum of advantage, is it worth while to go out of our way, and incur unnecessary expense in boring through the Taurus Mountains? As regards the question of steamers protecting the flanks of our communications, I think there must have been some little mistake, for there was nothing in the paper on that subject. I do not know how that idea arose; but we may trust the terminal ports of the Euphrates Valley route, in the Mediterranean and in the Persian Gulf, to the protection of our gallant friends of the Navy.

The Austrian War Minister with great foresight has shown us a very good example in looking forward for a series of years to the objects and proceedings of the Russian Government. Ever since 1858, he seems to have had his eye on their movements, and he has thus been able to foresee and foretell what they have subsequently carried out. In conclusion, and with reference to his writings, I would observe, it is devoutly to be wished that we had some heaven-born War Minister in this country, who like Bismarck and von Roon of Germany, and Cavour of Italy, would keep these sort of questions always in view, who would lead, instead of bowing to popular or parliamentary opinion in reference to them, and who would command the necessary influence to carry them forward, when of such supreme national importance, to a successful issue, to the great future advantage of this country, and of that Eastern Empire, whose destinies it has pleased God to entrust to its guidance, government, and development. Such possessions carry their responsibilities with them; and I firmly believe, as I stated many years since in a lecture on "The Routes to India," in this room, that the improvement of the communications through the countries lying

between Europe and India is one great object to be achieved, and one great reason for the common possession of Great Britain and India by the Anglo-Saxon race.

The CHAIRMAN: Ladies and Gentlemen, I venture to think I only represent your feelings when I say we have derived great gratification and instruction from the very able and lucid statements of Mr. Andrew, so ably read and commented upon by Captain Tyler. I hope you will join with me in voting our thanks to Mr. Andrew for his paper, and for the justice which has been done to it by Captain Tyler. I am sure that you will also agree with me that we are very much indebted to the various gentlemen who have given their opinions on this occasion; and although there may have been differences of opinion, yet it is always best in our country to hear all sides of the case, especially as they all point to one great object, a rapid, safe, and quick communication between England and her best and most valuable possession, India.

Monday, April 21st, 1873.

ADMIRAL TARLETON, C.B., Lord of the Admiralty, in the Chair.

NAMES of MEMBERS who joined the Institution between the 7th and the 21st April, 1873.

LIFE.

Littledale, H. W. A., Lieut. R.N.
Jocelyn, W. H., Lieut. R.N.

ANNUAL.

Bouverie, Henry H. P., Lieut. West Somerset Yeo.
Barnett, Henry, Lieut.-Col. Oxford Yeo.
McPherson, Cecil, Capt. 17th Regt.
Burr, C. E. G., Lieut. 17th Regt.
Shepherd, Henry, Capt. 2nd Kent Art. Volunteers.
Simpson, Frank, Staff Assist.-Surgeon.
Todd, J. A., Lieut.-Colonel late 14th Hussars.
Macpherson, J. C., Capt. R.E.
Abbott, Saunders A., Major-General late Bombay Army.

NAVAL RESERVES.

By T. BRASSEY, Esq., M.P., Captain Cinque Ports Artillery.

BEFORE commencing my paper, I may say that it is to me a matter of regret that the Navy is not better represented in Parliament. If there were more Naval Officers in the House, it would be much better for Parliament and better for the Navy. But, at any rate, those who take an interest in the subject must endeavour to learn what they can from their Naval Officers.

I appear before this Institution essentially as a learner and not a teacher. As a Member of Parliament, interested in our naval administration, I most anxiously desire to ascertain what, in the opinion of naval men, are our actual requirements as regards the number of seamen in reserve for the manning of the fleet. The public, and Parliament as representing public opinion, are prepared to provide, with an ungrudging hand, whatever the naval men declare to be essential to our maritime power and security. But it is for the Navy to tell the public what our requirements are.

In dealing with the great question of our Naval Reserves—a subject too vast to be considered as a whole within the narrow limits of a short oral address—I shall say but little of the actual organization of the force. I shall prefer to dwell on points which still await solution, and upon which the opinion and thoughtful consideration of naval men are greatly needed. There are three problems, which I will specially single out for discussion.

First.—What number of seamen ought we to endeavour to enrol, whether in the first or second class Reserve, or as Naval Coast Volunteers?

Second.—To what extent may we venture to rely on the merchant service to provide Officers for our Navy in time of war?

Third.—What are the most effectual means of raising and training a force for the especial purpose of coast defence?

I proceed to apply myself to the first of the three problems, which I have submitted for the consideration of the Institution.

The enquiries, instituted in 1852, as to the probable requirements of the British Navy, elicited the usual divergency of opinions from the Naval Officers who were consulted.

As to that word "usual," I may state that civilians, who have studied Naval Blue Books with the attention I have devoted to that somewhat voluminous literature, must experience great difficulty in taking any useful part in naval matters in the House, on account of the great divergency of opinion therein exhibited. I have to-day devoted two or three hours to the perusal of the evidence which was given before that very important Committee of Officers who inquired into the Life Boats supplied to the Navy, and it is surprising how witness after witness appear to give an opinion totally opposed to that which had just been delivered by the preceding witness. I therefore hope the Naval Officers will excuse my using the word "usual." To return to my subject.

Sir John Stirling estimated that 60,000 men would be necessary to man the Navy in time of war. Admiral Denman, on the other hand, believed that, on the outbreak of a war, a fleet of 100,000 men would be immediately required; but, inasmuch as of the 40,000 employed in 1852 only 15,000 were seamen, he believed that of the 60,000 additional men required for a war Navy, only 23,000 need be seamen.

The effect of modern mechanical appliances, in relation to the manning of the Navy, was scarcely perceived at the time of the Crimean war; but the fact that the number of seamen and marines employed in the British fleet, at that period, never exceeded 68,000, afforded some indication of the coming change.

In the recent civil war in America, the Navy of the United States was increased to vast proportions.

Land defences of great strength were attacked by their ships. An effectual blockade was maintained along 3,500 miles of coast. A fleet of cruisers was despatched in chase of the "Alabama," and other piratical vessels, to every part of the world. To perform these varied services, some 671 vessels were employed; but, such was the effect of modern changes in naval warfare, that the number of men employed in the United States fleet never exceeded 51,000 men.

The blockade of Charleston is one of the most striking examples of the reduced numbers of seamen required in modern naval warfare.

The report of the Secretary of the United States Navy on armoured vessels, published in 1866, contains a despatch from Admiral Dahlgren, dated off Morris Island, January, 1864, in which the following observations occur:—"The completeness with which four little monitors, supported by an ironclad frigate, have closed Charleston, is well worth noting. These four monitors, which thus keep watch and ward, muster eight guns and 320 men, which is almost insignificant compared with the work done."

The conditions of naval warfare have, in our days, been so completely revolutionised that the experience of the past affords but a slight clue to the requirements of the future.

In 1805, a year memorable in our annals for the crowning naval victory of Trafalgar, 114,000 seamen and marines were voted for the naval service. This number was increased, in subsequent years, to 147,000; but it is certain that our naval power derived no advantage from the increase in the numerical strength of our naval forces.

An eminent Officer of the United States Navy, Admiral Goldsborough, has stated, in a memorandum addressed to his Government, that the most effective vessels for coast defence will be swift and handy armour-clad ships without guns, and to be used exclusively as rams. By the adoption of vessels of the type recommended by Admiral Goldsborough, the number of men in our flotilla for coast defence might be materially diminished.

The last Royal Commission on the manning of the Navy, reporting in 1860, had not the experience of the American war, as a guide for determining our probable requirements. But, inasmuch as their report contains the latest authoritative exposition of professional opinion in our own Navy, it deserves attentive consideration.

The following statement exhibits the whole amount of reserve, which they recommended:—

Reliefs in the home ports	4,000
Coast Guard	12,000
Marines embodied	6,000
Ditto, short service pensioners	5,000
Seamen, short service pensioners	3,000
Royal Naval Volunteers	20,000
Naval Coast Volunteers	10,000
	60,000 men

Since the publication of the Report of the Royal Commission of 1859 naval warfare has been almost revolutionised. When, on a recent occasion I introduced a motion in the House of Commons, on the condition of our Naval Reserves, I urged the appointment of a Select Committee to inquire into the subject, mainly on the ground, that in consequence of the immense changes which have taken place, the number of seamen required for the Reserve, could no longer be taken as definitely settled by a report drawn up some fifteen years ago. How great a change has taken place in this regard was clearly shown in the able speech of Mr. Shaw Lefevre, in which he pointed out that, at the date, when the inquiry of the last Royal Commission was held, the flag-ship in the Meditertanean required a complement of from 600 to 700 blue jackets, while for the present flag-ship, the "Lord Warden," 200 are sufficient; and, if the "Devastation" represents the flag-ship of the future, in European waters, then 100 able seamen will do the work, for which, in the good old times of full-rigged three-deckers, a crew of 600 seamen was essential.

I believe I am correct in saying that at the present moment we have

not more than 32 or 33 ironclads afloat, adapted for cruising in distant waters, or for service in which the aid of sail-power may be regarded as indispensable. Some years must elapse ere our ocean-going ironclad fleet can be increased to a total number of 50 vessels. If it be fair to take the crew of the "Lord Warden" as representing the average number of seamen required for one-half of our ironclad fleet; and if the complement of the "Devastation" may be accepted as the normal number for ships of her class; and, to judge from the Naval estimates of the present year, one-half of our new ironclads will be mastless ships; then it would appear probable that we should require for the complements of a fleet of 50 of the most powerful ironclad ships, not more than 7,500 *boná fide* seamen. For a fleet of 50 ships of the type, to which the flag-ship in the Mediterranean fifteen years ago belonged, we should have required a force of 30,000 seamen. The inference seems to be irresistible, that in a future naval war we shall not require so many seamen as formerly for our ocean-going line-of-battle ships. Making every allowance, therefore, for the increased importance of the commerce, and assuming that, in consequence of the withdrawal of the troops, the defence of the colonies will be in a larger sense than heretofore committed to the Navy, I venture to submit it, as my opinion, that we no longer require 20,000 seamen in our first-class Reserve. The first-class Reserve now numbers about 12,000 seamen, very carefully selected; and if 10,000 men answered to their country's call, we should find it difficult to make use of their services. Hence, I arrive at the conclusion, that we are in a highly satisfactory position, as regards the numerical strength of our Naval Reserve.

The policy of creating additional means of training seamen for the Reserve must depend mainly on the views entertained in the Navy, as to the strength, at which that Reserve should be maintained. If our present Reserve be really inadequate; then training ships, with brigs attached as sailing tenders, should be at once established, at least in London and Liverpool. If, on the other hand, the actual strength of the Naval Reserve is adequate; then naval reformers will not be justified in urging upon the consideration of Parliament proposals for training young seamen for the reserves at the public expense.

Before I pass to the second subject with which I have to deal, I would invite Naval Officers to say, whether or not they think that the seaman of modern times has deteriorated by comparison with his predecessors. I believe that it is the opinion in the Navy, that so far as that branch of the great marine of England is concerned, the greatly improved system of training which has been established, has produced in the seaman of modern times a very valuable man. But it is well known to Naval Officers that the mercantile marine do not consider themselves quite so fortunate. Whether or no that public opinion is founded upon good and substantial reasons, it is very difficult to determine. One knows that in other spheres of life it is very common to say there is nothing so good as the "good old times," and no doubt that tendency to disparage the present and exalt the past, is manifested in naval as well as in other spheres of society. Speaking as a yacht-owner of some

eighteen or nineteen years' standing, I am bound to say that the class of seamen we employ, I believe now 8,000 in number, do not appear to me to have shown the slightest deterioration.

I desire now to make a few observations on the Officers of the Reserve. There is no profession in which so much talent is lost for want of opportunity for its exercise, none in which so much honourable ambition is doomed to disappointment, as the Navy. The half-pay list contains a multitude of names of Officers without private means, and eager for employment, which is denied to them for the greater part of the best portion of their lives. Can we not remedy this evil by first creating a reserve of Officers in the mercantile marine, and then reducing the number of Officers in the Navy to something like the number actually required in time of peace?

At the present time, young gentlemen, socially qualified, in every way, for service in the Navy, are being educated on board the "Conway," in the Mersey, and the "Worcester," in the Thames. If the Admiralty were to afford to these Officers, after they have passed their examinations as masters and mates, the opportunity of adding to their nautical education, received at sea, a competent knowledge of gunnery, we should have in them an invaluable reserve of Officers.

For this purpose, a short practical course of gunnery and naval tactics should be arranged, in connection with the "Excellent," analogous with the course of military instruction which has been arranged for Volunteer Officers at Aldershot. Eligible young Officers of the mercantile marine should be encouraged to go through the course by the offer of a premium, to be paid to them on their passing a satisfactory examination. The premium should be sufficient in amount to cover the expense of their residence in Portsmouth, and also to compensate them for their loss of time in not going to sea, while remaining on shore for the purpose of study.

The Board of Trade would do much to promote the success of this scheme by raising the standard of examination for the extra-master's certificate, which might be extended so as to include both modern languages, and the more important elements of commercial science. The privilege of going through the course on board the "Excellent" might be confined to those Officers who had passed this higher examination. I would urge the endeavour to raise the status of the Officers of the mercantile marine as an object of high administrative policy, essentially philanthropic in its tendency.

There is no position more full of responsibility, none, in which there are greater opportunities of doing good or harm, than that of commander of a merchantman. In distant seas, far removed from the influence of public opinion, the sea Officer has unlimited powers of raising or lowering the character of his crew, and alleviating or aggravating the inevitable hardships of their lot.

The creation of the Naval University at Greenwich will doubtless do much to facilitate the fusion between the Officers of the Reserve and the Navy, which, from every point of view, is so much to be desired.

Unless it be accepted as an axiom, that young gentlemen should not

enter the Navy, without being possessed of the advantage of considerable private means; the present half-pay system is a serious evil. There should be no half-pay for Officers on the active list. After service at sea, a fair amount of leave should be granted. In all ranks, a year ashore for every three years passed afloat would not be too great an indulgence. If the numbers be reduced, useful employment could always be found for all Officers in the higher ranks of the Navy, in developing the numerous novel inventions for naval warfare, in watching the progress of gunnery, in criticising the recent modifications in naval architecture, or in applying their attention to the safety of life at sea, and other kindred subjects. There is always much work to be done for the Navy and the mercantile marine, with which naval men are specially competent to deal.

From the Royal Naval Reserve and its Officers, I turn to the Coast Volunteers. Recent naval administrators have unaccountably neglected this branch of the Reserves.

The Committee of 1852 recommended a force of 6,000 Coast Volunteers, and the Royal Commission of 1859, advised that the number should be 10,000. According to the latest estimates, the number has been reduced to 600 men. It cannot be said that eligible men are wanting. The latest return shows that 153,000 men, and 14,000 boys are employed in the fisheries of the United Kingdom. In point of physical power and hardy habits, the fishermen are superior to the seamen in foreign trades. Their local knowledge would be of immense value in coast defence, and the fact that they have fixed places of residence, and never sail under a foreign flag, makes it certain that they would always be found when their services were required. Of the moral character of the fishermen, as a body, I can speak with the greatest confidence. The Coast Volunteers are not a popular force in the Navy. The reason is that, for political purposes, the men originally enrolled, were admitted into the service with discreditable laxity.

It would not be difficult to raise, from among our large population of *bonâ fide* fishermen, a Reserve equal to the standard recommended by the Royal Commission. I hope I am justified in drawing the inference, from a perusal of the revised rules, that there is a disposition to induce the fishermen to join—not the Naval Coast Volunteers—but the Second Class Naval Reserve. The means, however, which are proposed for carrying out this policy are inadequate. The fishermen are congregated in isolated communities on various points of the coast. They are men of domesticated habits, and it would be difficult to induce them to join the Reserve, if they had to go to a distance from their homes to be drilled.

The list of ships and batteries at which the Naval Reserve may take their drill, though imposing enough in point of numbers, does not include some of the most important fishing communities on the coast of the United Kingdom. For example, while there are batteries for drill at Poole, where the number of men and boys employed in fishing vessels is only 214; at Maryport, where there are only 69; and at Lynn, where there are only 266; there are no similar establishments

at Sligo, which has 4,800 men and boys in the fishing vessels of the port; none at Skibbereen, which has 5,500 fishermen; none at Banff, which has 5,600; nor at Stornoway, which has 8,000; nor at Wick, which has 8,400; nor at Inverness, which has 9,000 fishermen; and if I were to go round the coast, enumerating the places where the number of fishermen ranges from 1,000 to 3,000, but where there are no opportunities for the men belonging to the Reserve to drill, I should weary you with the enumeration.

The list which I have read is sufficient to show what immense numbers of fishermen are collected at some of the Scotch fishing stations; and these men are, as it is well known, remarkable for their physical strength, hardy habits, and good character.

In view of the importance to the Navy of recruiting in this section of our maritime population, the Manning Committee of 1852, strongly recommended that the Scotch Naval Station should be re-established. Where the Navy is best known, as they truly observed, there the flower of the population are ready to enter it. In 1852, there were more men in the Navy from the village of Cawsand, than from the port of Liverpool; and the return of the counties, in which the boys in the training ships in 1871 were born, shows that out of 2,888 boys, only 90 came from the whole of Scotland; only 112 from Lancashire, including the Isle of Man as well as Liverpool; only 23 from Suffolk; 11 from Norfolk; and 18 from Wales. Can it be supposed that the great seafaring populations, which reside on those coasts have ever been made thoroughly acquainted with the advantages enjoyed by those who serve in the Navy and the Reserve? The fluctuating nature of their occupation would enable the fishermen to attend drill with little inconvenience. The drill could be taught in the most effective manner, and with the least expense to the Government, by sending a gunboat to visit the fishing ports at the slack season. These periodical visits of a smart, well-organized gunboat, would do much to create a favourable impression of the Navy amongst the fishermen. The expense of keeping a few gunboats in commission for this purpose would be nominal; for we have more seamen at present in the home ports, than it is possible to employ in sea-going ships. Some of these men might be attached to gunboats instead of remaining in stationary flag-ships.

The display of the white ensign in the fishing ports would be a more effectual means of recruiting for the Reserve than the labours, however assiduous, of any number of registrars, and the barren exhibition of recruiting placards.

I have ventured to express an opinion that the standard of strength for the first-class Naval Reserve would not be inadequate, if maintained at 10,000 men. But for the coast defence force, I cannot regard the number proposed by the Royal Commission, in 1860, as beyond our necessities. Though naval warfare may be changed, the services of men well acquainted with our own waters must always be invaluable, whether to man our gunboats, to lay out torpedoes, or even to fight heavy ordnance in batteries on the coast, and to co-operate with the military forces in operations on shore.

To some it may appear doubtful whether all the dash and *élan*,

required for naval operations, is to be found among the stay-at-home people, who earn a livelihood in our fisheries. Had they seen, what the author has often witnessed, the agility, the seamanlike resource, and the nerve, which these men never fail to display, in the ever-varying incident and adventure of sea-life, they would no longer doubt their aptitude, if properly trained, for every duty which the crews of our coast flotilla may be called upon to perform.

The enrolment of fishermen in the Reserves has been advocated by our most experienced naval reformers—by Sir Charles Napier; by Admiral Berkeley; by Sir William Hall; by Admiral Hastings; by the late Sir Alexander Milne, and by many other most distinguished Naval Officers.

Sir Charles Napier proposed that our Steam Reserves should be stationed at the different ports; that the Officers and crews of the Coast Guard should be on their books, and that their complement should be completed from the boatmen and fishermen on the coast.

Admiral Berkeley, who had devoted the greatest attention to the manning of the Navy, was strongly in favour of the enrolment of fishermen in the Reserves. They were, in his view, to be regarded, as a sea militia, to be employed for coast defence in steamers and steam gunboats, not to go beyond the channel. He advised that they should be called out periodically, and that they should be clothed when so called out; and that they should be paid on a corresponding scale—*cæteris paribus*—with the land militia.

Admiral Berkeley expressed the most implicit confidence in the fishermen, as a body of men who could be organised, as a sea militia, for coast defence. With these men behind him, he declared that he should be perfectly satisfied to take his share in the responsibility of defending our shores, and making the channel a place of refuge for our flag, until more extensive means were adopted for manning the fleet.

Admiral Hastings, one of the witnesses examined by the Commission of 1852, gave similar evidence, to the effect that the fishermen would be well adapted, on an emergency, for the naval service; and that their stationary habits were a strong point in their favour.

Captain Oliver, another witness before the same Committee, whose recent connection with the Coast Guard had given him peculiar opportunities of observing the fishermen in various parts of the coast, spoke of the fishermen of the Isle of Wight in the following terms:—"At South Yarmouth, a notorious smuggling district, which I commanded for six years, the terms fisherman and smuggler were synonymous; yet I could not but respect them as a noble as well as a hardy race. I consider fishermen, generally, of very domesticated habits."

The most desirable men for the Coast Defence Sea Militia are to be obtained at Penzance, Brixham, Brighton, Hastings, Folkestone, Deal, Barking, Colchester, Lowestoft, Yarmouth, Cromer, Berwick, Dunbar, Newhaven, Anstruther, Aberdeen, Peterhead, Cromarty, Wick, Shetland, Orkney, and the western islands of Scotland.

When the Officers of the Coast Guard were consulted on this subject, in 1852, many of their number recommended the fishermen as being highly qualified for service in the Coast Defence Corps.

The rules for admission into the Coast Volunteers should be so framed as to require only such seamanship as every experienced fisherman must possess. Training in gunnery and small-arm drill are the only additional qualifications needed, to make our fishermen thoroughly useful in the Coast Defence Flotilla.

I am happy to observe that, in the recent revision of the rules and regulations for the Naval Reserve, the conditions of entry for the second-class Reserve have been judiciously modified, so that the fishermen will now be eligible for enrolment.

The training should be given afloat, and, in order to propitiate the local sympathies of the fishermen, the gunboats, which they would be employed to man in times of war, should be permanently stationed at the ports in which their crews are respectively raised.

Officers should be selected to command the Coast Defence Reserve, who have exhibited special aptitude for that branch of the service. They should reside at the principal fishing ports, and be permanently attached to the Coast Defence Service. By these means they would have the inestimable advantage of being personally acquainted with the men under their command.

In his evidence on the manning of the Navy, in 1852, Admiral Berkeley stated that special care should be taken in the selection of Officers for the Coast Defence Service, and that it was essential that all the Officers, and particularly the Commanding Officer, should be accustomed to the fishermen and they to him. In addition to the proposed drills in gunnery, and the use of small arms, it would be highly expedient that Officers and men should make themselves locally acquainted with the channels and entrances to the harbours in their respective districts, and be instructed in the use of the torpedo, and its application to coast defence.

The appointments in this service should be liberally paid, and—in consideration of the advantages of a higher rate of pay and a fixed place of residence, the latter a great boon to a married man—Officers in the Coast Defence Service ought to be content with a slower rate of promotion than that accorded to their brother Officers, serving on foreign stations.

The annual drills afloat, and the musters of the Coast Defence Flotilla for inspection by the Divisional Captain of the Coast Guard, or for inspection, in larger numbers, at naval reviews, would secure the continued efficiency of the Officers of the Coast Defence Service in seamanship and navigation.

In addition to the various descriptions of forces already enumerated, an attempt has been made to extend the Volunteer movement to the Coast Defence Service. A corps, composed, at present, of 100 gentlemen employed in banks and private offices in the City, has been provisionally enrolled, and several hundred additional applications for admission have been received. The Volunteers actually entered have attended drill on board the "President," and I am enabled to state that, in the opinion of the instructors, they are the most intelligent and the smartest gunners who have ever been drilled on board the ship. A gun's crew of fifteen gentlemen have recently passed out as trained

men, and the senior instructor tells me that they are unquestionably the very best gun's crew, who have ever been drilled on board the "President." The movement has extended itself to Liverpool, where the First Lord of the Admiralty did so much to initiate it by an encouraging speech. It remains to be proved whether the idea can be carried out in a practical shape. Not until the Volunteers have been afloat in a gunboat for a few days, and have shown their ability and readiness to perform all the duties, which devolve on the crew of a gunboat, shall I venture to regard the experiment, with which I have the honour to be associated, as an accomplished fact.

The experiment, however, of sending landsmen afloat has been tried on the American lakes, where in the seasons of 1871 and 1872 three batteries of artillery were embarked in the dominion gunboat "Prince Alfred," remaining afloat, each battery for fourteen days, cruising on Lakes Huron and Erie, and taking part in the military manœuvres, which were carried out by the Canadian Volunteers under the command of Sir Hastings Doyle. I can quote another example of the readiness with which landsmen adapt themselves to some descriptions of sea-service. In the herring fisheries off the coasts of Norfolk and Suffolk, boats are manned, to a large extent, by agricultural labourers. In hauling in the herring nets, the crew have to walk a distance of eight miles round the capstan every morning. It is obvious that men, who can perform such an amount of labour on board a herring-boat, would be perfectly fit for a gunboat.

Much of the success of the Naval Volunteer movement much depend on the readiness of the Admiralty to afford the necessary facilities. The most immediately pressing matter is the appointment of a commanding or inspecting Officer. Until the Admiralty place a naval man of rank and experience at the head of the Volunteers, an invaluable aid to efficiency will be wanting, and the formation of a contingent at many of the ports round the coast will be indefinitely delayed.

I have received applications from Southampton, Dundee, Wales, Musselburgh, Harwich, and Bristol, for assistance and advice. It is very desirable that a Naval Officer should be available to visit these localities where a disposition exists to organise a local corps of Naval Volunteers, and I am happy to be enabled to state that the appointment, which I so earnestly recommended, will shortly be made.

The appropriation of a gunboat for the instruction of the members of the London contingent is equally indispensable to the success of the Naval Volunteer movement. Practice in firing at a target afloat, and in working a gun mounted on a gunboat is necessary for efficiency. On the other hand, the opportunity of spending a week every year on the water is essential to the popularity of the movement. In a time of profound peace, and in a country, in which the principle of compulsory military service has not been accepted, men will not volunteer for the somewhat laborious task of going through an annual course of naval gun drill, without some inducement. That inducement, in the case of the most earnest men, who have joined the Volunteer movement, has been found in the hope, in which they have indulged, that they would

thus obtain the opportunity of spending a few days afloat every year. The gunboat appropriated to the Volunteers in the Thames might also do duty as a tender to the "President," the drill-ship of the Naval Reserve in the London district. Hitherto, none of the seamen belonging to the Reserve in the Port of London have ever had any practice in firing at a target afloat. At Liverpool, on the other hand, a gunboat is attached to the drill-ship, in which the seamen of the Reserve are regularly exercised. The Volunteers would not urge upon the Admiralty the expenditure of money especially on their behalf; but the inconvenience of attending drill in the West India Docks to gentlemen, whose usual pursuits are in the City or the West-end, is so great, that the London contingent can never become very numerous, until more suitable arrangements can be made. A gunboat of the "Comet" class, moored off Somerset House, would afford the necessary facility, and would cost less than fitting up a wooden ship of larger tonnage. Gun-drill could not take place on board in the winter evenings ; but, at that season of the year, the evenings should be devoted to cutlass and rifle exercise, and the gun-drills might take place on Saturday afternoons, when the Volunteers could conveniently attend.

We have now considered the Reserves of all classes, which it is possible to raise on our shores ; but the naval resources of Great Britain are by no means limited to these islands. I have returned from a recent visit to our North American colonies, strongly impressed with a feeling of regret that no attempt has been made to encourage the colonists to form reserves among the hardy mariners, who sail under the British flag in North American waters. We have not hesitated to enrol our coloured fellow subjects in the land forces in many dependencies of the Crown. Why should we not encourage the colonies to form a Naval Reserve for the defence of their own coast ?

In the Canadian dominion and Newfoundland, there are 87,000 seamen and fishermen, of whom one-third belong to Newfoundland alone. The fishermen are compelled, by the inclemency of the season, and the closing of the navigation by ice, to remain at home for a considerable portion of the winter. A gunboat might be stationed at St. John's, and another at Halifax, for the purpose of drilling the colonial reserves, gradually proceeding from harbour to harbour on the Atlantic coast in winter, and ascending the Gulf of St. Lawrence at the approach of spring. The local reserve might be drilled in the slack season of the fishery, and before the navigation became completely open from the melting of the ice. With some aid and encouragement from the mother country, it appears to be perfectly feasible, and most desirable, for the Canadian dominion and the adjacent colonies to organize a force for the defence of their coasts. I throw the suggestion out for the consideration of the Government at home, and the authorities in the colonies.

Lastly, the formation of an able staff of Inspecting Officers for the Reserve is essentially necessary to secure their efficiency. The Reserves, including the Coast Guard, now number not less than 20,000 men, surely the supreme command of such a force is a task worthy of the

most distinguished Admiral in the service. The Commander-in-Chief should be supported by a staff of Officers, to whom should be assigned the command of the Reserves in the St. George's Channel, and on the east coast of England. While, hitherto, there has been no inspecting staff for the Naval Reserve, a very different policy has prevailed at the War Office in providing a staff for the inspection of the land volunteers. An Admiral sent on an occasional tour of inspection, is not a sufficient substitute for an Officer specially devoted to the duty, and whose representations as to the requirements of the Reserve would receive an amount of attention at the Admiralty, which could not be secured by any other means. The Commanding Officer of the Reserves would always feel that his professional reputation was intimately involved in the success or failure of this branch of the *personnel* of the Navy.

In urging the appointment of a staff of Superintending Officers, I do not undervalue for a moment the services of that admirable body of men, the seamen instructors in gunnery in the drill ships of the Reserve. It is impossible to speak too highly of their zeal, their intelligence, their discipline, and their consummate knowledge of the subject, on which it is their duty to give instruction. But Naval Officers, judiciously selected, would exercise a higher influence over the *morale* of the Naval Reserve. The merchant seamen would feel themselves, in a larger sense than heretofore, an integral part of the Navy in England. They would be inspired by its great traditions, and the confidence which they would acquire in the Officers, under whom they received their training, would be an invaluable guarantee for their conduct and discipline, should they ever be called upon to serve in Her Majesty's fleets.

Commander Gilmore, R.N.: I think, Sir, that I may speak of the Naval Reserve with some authority, having had Naval Reserve men under my individual command more than three years. I cannot think that the Naval Reserve will ever be fit to take the place of our own seamen on board our men-of-war. Our own seamen are educated from their boyhood, and are brought into the Navy at an early period. Merchant seamen, on the contrary, come in at all ages and are perfectly undisciplined, and they appear to come into the Reserve merely to receive 6*l.* bounty, and so much grant. It is well known that in 1868 when the Reserve were called out, out of 16,000 men supposed to be enrolled, only 1,700 put in an appearance on board the Fleet at Spithead, and those men had been further induced to come by being presented with two suits of clothes. Mr. Brassey speaking about the "Alabama" and "Charleston," and the American war, states that four monitors were sufficient to blockade Charleston. (Mr. Brassey: I was quoting the passage in the despatch of the Admiral.) Four monitors were sufficient, for the Southerners had no men or ships to force the blockade. Then, on the question of rams, there were only two cases in the whole of the American war in which rams were used, and one case in the Italian war. Mr. Shaw Lefevre said, that in the old time 700 men were a complement for a ship; but the "Lord Clyde" never had so few as 200 men as her complement. Archidimadas, the Spartan, said, in the old time, he required enough good men to keep bad men away from the shores of Sparta. But to keep bad men away from our shores we must have sea-going ships fully masted, and our present complement of seamen is not nearly sufficient to man these ships. The Naval Reserve, willing as they are to carry out their duties, are undisciplined, and as far as I know from their appearance, unequal to the carrying out of naval duties. The Coast Volunteers, who were 10,000 at one time, are mostly composed in the Welsh districts of men from Cardiff and Newport, nearly all miners, and Irishmen; on board the "Revenge," out of 1,500 men only 135 could go aloft. Some few of the Naval

Reserve men that we had, had been seamen in their time, but the majority had left the sea and were fishermen, stokers, engine-drivers, hotel porters, butlers,—anything you like but seamen. The same thing occurred in Scotland. There Captain Fellowes found—you will find it in the Admiralty Report—that nine-tenths of his men were actually employed on shore; they were, as I said before, hotel porters, stokers, men on the railways, while others were fishermen. Men came on board and said they had been seamen; they produced in the first place, certificates of having served at sea, and thought there was nothing further required of them save to drop in occasionally just when they chose. If they found the service was agreeable to them, they stopped and came the next year for their drill; but if Officers were unpleasant and required them to do their duty, they went somewhere else, went to Southampton, and if the people at Southampton were not pleasant, they went to Wales. My experience was in Wales, and I can assure you, that I consider that the Naval Reserve men now, are no more fitted to take their place on board a man-of-war, than a sweep is fitted for the post of colour-sergeant in a regiment. They were perfectly undisciplined, they were not seamen, were perfectly undrilled, and they took every possible means they could to stir up indignation and insubordination among the crew. The coalheavers and pitmen from Cardiff and Newport when they came tried to do their best; the other men came with the idea that they were perfect seamen, and that they were entitled to come on board and take the position among our men, that they did. The pay was better, their duties were less, and they had only eight hours drill in a day, no drill on Saturday or on Sunday. The whole of their emoluments amounted to $9\frac{1}{2}d.$ an hour. I believe our Reserve must in future be brought up in the Navy from boys.*

Captain Willes, C.B., R.N.: My excuse for speaking this evening is simply that, for three years and a half, I superintended, at the Admiralty, the Coast Guard and Naval Reserve (during the temporal absence, I may say) of our gallant chairman from Whitehall. In the first place, I must on the part of the Navy thank Mr. Brassey for the very great interest he takes in naval affairs. We are only too glad to see an honourable Member, who will bring naval matters before the House, and discuss them fairly, as he does; and we hope the time is not far distant when he will hold an important post, either at the Board of Trade or at the Admiralty. Mr. Brassey has, indeed, in his interesting lecture, raised some most important questions, and I fear that, in endeavouring to touch on some of these, I may exceed the limited time allotted by the rules of this Institution. Ten hours instead of ten minutes would still leave much unsaid, and I therefore trust I may meet with indulgence, should I be led to transgress. Mr. Brassey has alluded to the fact of there being so few naval Members of Parliament. I shall be very glad if he, or anyone else, will tell me how that is to be remedied. To begin with, we are, as a rule, poor men, and secondly, it is very difficult for us to serve our profession and Parliament also. If we go into Parliament we must take a party side, and this too often, injures our professional career. At the same time I think it is unfortunate for the service; that we are not, like the Army, numerously represented; for, although I have a great respect for Members of Parliament in general, it is almost impossible that any man should discuss, with advantage, purely technical questions of which he has had no personal experience. The retirement scheme of Mr. Childers I believe to have been for the good of the Navy generally, but it increased the difficulties in the way of Naval Officers sitting in Parliament. An Officer cannot well enter the House until he is qualified for flag rank; then, after a few years, he either must treat his constituents badly by resigning his seat, when he wants to hoist his flag; or relinquish the service altogether.

Mr. Brassey alluded to the remarkable divergence of opinion prevailing amongst Naval Officers. Well, it is certainly to be regretted, but cannot be remedied. We go to sea when very young, under different kinds of Officers. We often imbibe our ideas entirely from them, and they may be said to influence the whole of our future

* These, after a certain number of years' service in the Navy (not less than 12 years), should be discharged into the Reserve with pensions according to length of service; they might begin on $6l.$, the amount of retainer paid annually to each man in the Reserve.

career. I particularly remember,—for I was one of the Lifeboat Committee alluded to by Mr. Brassey, when the diversity of opinion, as the evidence given by the witnesses shows was so remarkable.

Mr. Brassey invites Naval Officers to state what number of seamen, as a Reserve, would be required in case of war? Now, that is one of the most difficult problems he could possibly put forward. What war is it to be? Is it to be a maritime war or a European war? That is to say, is it to be a war with America or a European power? If it was war with the latter, I believe, to commence, we are well provided, but if it is war with America, then we should have to cover the sea with "Alabamas" to protect our commerce, and he would be a very clever person who could say how many. Then comes another question. What is to be the ship of the future? If the "Devastation" is to be the type, the number required would be very small; but I believe the time is not very far distant, and that there are some of the younger members present who will see it, when armour will be entirely taken off our ships. We may not go back to three-deckers, but I believe we shall return to frigates and corvettes with many guns and large crews; then we should require a very large number of men in the Reserves. But looking at the "immediate future," an expression made use of by Lord Dufferin's Committee, which sat at the Admiralty last year, I believe we are tolerably rich. If the Naval Reserve could be raised again to the number which the Admiral in the Chair left in 1869 (namely, 16,000), with our Coast Guard and our Pensioner Force (which is very considerable), I think we might be quite happy. But the question is, how to keep up that 16,000? It is a very important subject. When the present Government came into office, I think the naval representative, Mr. Childers, held the opinion which I was sorry to hear Commander Gilmore again express this evening, of the Naval Reserve, and, you will remember, he called them out on a Whitsuntide cruise. It was a very bad time of the year, and we only collected 1,600 or 1,700; but Mr. Childers came back from that cruise convinced that, whether it was right or whether it was wrong to establish the Naval Reserve in the first instance, it never should be abolished. Admiral Key, who commanded the squadron, pointed out certain defects in the system, and he certainly did hit upon some of the blots mentioned by Commander Gilmore. The consequence was, a Committee sat at Whitehall (of which I was a member), and recommended considerable modifications, in order to remedy the evils pointed out by Admiral Key and other Officers. What was the result? These restrictions, as they were called by Mr. Brassey, reduced the force to 11,500 men, but these 11,500 men were certainly prime seamen. In the meantime other difficulties arose, and there was no greater one, than the Suez Canal. The Suez Canal has indirectly hurt our Naval Reserve, because, for the moment, it has swept away a large number of sailing ships, and has increased the number of steamers immensely, and the steamers that now go to India, China, and Australia through the canal, are manned by inferior seamen, who are not qualified for the Naval Reserve. Again, the increase of steamers in our home trade has acted against us. I was at a seaport the other day, and meeting an old shipmate, I asked him why he had not joined the Naval Reserve. His reply was, "It is impossible now, Sir. We cannot take our drills. These steamers along the coast come in, and go out of port again; so rapidly." So great is the competition, that their cargoes are taken out and the vessels loaded again and started; frequently in 48 hours, so that the men have not time to take their drill. Therefore, we have the Suez Canal and the immense increase of our steam commerce acting against us, and how the Naval Reserve is, under the circumstances, to be raised even to 13,000 efficient men is a puzzle.* I have been absent some months from England, and therefore only to-day, read Sir Frederic Grey's pamphlet, and if anybody here has not read it, I would advise him to do so. I was

* Return from Board of Trade, 21st December, 1872, points to a considerable decrease in the crews of steam vessels, thus—

Proportion of *men* to 100 tons.

1854—7·47
1869—4·92
1870—4·67
1871—4·55

in the House of Commons when Mr. Goschen made the speech which Sir Frederic Grey alludes to, and for the moment I thought Mr. Goschen was right. He said that he did not consider it any part of the duty of the State to educate sailors for the mercantile marine. But it must, sooner or later, be done. Sir Frederic Grey says, very truly, "We must keep up our Naval Reserve." You cannot go back to the navigation laws. The competition is so great you cannot introduce apprentices forcibly into the merchant service, and therefore the State must help the mercantile marine. The men that we want for the Naval Reserve of the future must be trained men, for the gallant Admiral very properly points out, that those who were collected together in the panic of 1859-60 are not what we want now, and therefore, as the State gains by the competition and extreme riches of the country, produced, I believe, in a great measure by the abolition of the navigation laws, the Chancellor of the Exchequer must eventually spare a part of his surplus to assist the mercantile marine; and the men, in some way or other, must be passed through a short course of training in a man-of-war. How it is to be done I cannot tell you, for I know well, and so does the gallant Chairman, that, at this moment, we do not know what to do with the boys we are obliged to train for the Navy, for we have now to train every one of our seamen from boys. Instead of the merchant service being, as formerly, a nursery for the Navy, it is just the reverse, and positively the establishment of this very Naval Reserve, giving the men 10*l.* a year, tends to keep them out of the Navy. But it is a necessity. The Naval Reserve cannot be abolished, so that the sooner the State takes it up the better. We must have a larger force at sea in the Navy. We must have more unarmoured ships; we must have more regular training ships, and there must be a regular system for our Reserves, as our lecturer has said, under some distinguished Commander-in-Chief. I gather that Mr. Brassey rather finds fault with the Admiralty for abolishing the Naval Volunteers. All I can say is, they were abolished on the recommentation of Admiral Tarleton and the Captains of the—in *those* days—Coast Guard, now, first Reserve ships. And I believe, so far as the coast of England is concerned, it was right; but I do think that they might be kept up in Scotland still, to a limited number. The report from the west coast, when I was at the Admiralty, was in their favour. I think they might be maintained at about 2,000 in number there, and that was the determination of Mr. Childers, before he left the Admiralty. Then comes the very difficult question, "what are we to do for Officers in case of war?" I daresay Mr. Brassey is aware that every Naval Officer, whether on half pay or retired pay, can, by the power now extant, be called upon to serve in case of an emergency; therefore, I think that it would be possible to get the necessary Officers. They would be a little rusty, no doubt, but I believe many and many a young Officer who, for private reasons has retired from the Navy, would gladly come forward in case of an emergency, and therefore the Officer difficulty may be got over. (Mr. Brassey: The half-pay difficulty.) Yes, that is the point. Well, the half-pay difficulty is an immense one. How to keep Officers efficient for war is what no one can say. You cannot have a larger force. Parliament say, "We will give you 60,000 men and the proper proportion of Officers." You cannot have any more, and yet if war breaks out to-morrow, that force must be trebled or quadrupled; but that we could get Officers better than in the last war I thoroughly believe. One of the last points that Mr. Brassey has alluded to is, what I might call, "amateur sailors." I see that, during my absence abroad, Mr. Brassey has been trying to establish amateur sailors. (Mr. Brassey: Not sailors.) Amateur Officers. Well, I am very sorry to see it. I protest against it most strongly, and I hope my brother Officers will protest against anything of the sort. The Army has just given them up, and I really think in the present day, with our experience, the idea that amateur Officers would be efficient is utterly absurd. What is war? If war consisted of this: that an ironclad—notice having been given by electric telegraph—was coming off the port of Liverpool to wait until the amateur Officers could be got together to go out to fight her, that would be a very simple matter, provided they were not sea-sick. Fighting is not pleasant, but it is over in a few hours. But we all know that, in reality, war is quite a different thing. You have months and months of waiting, and at last the opportunity comes. Do you suppose for one moment you could take these young barristers and other gentlemen from their occupations for the period of eight, ten, twelve, or fourteen

months on the chance of there being a fight at the end of that time for a few hours? I cannot think it. I do not think we quite understand what war is, and so if you will allow me I will read you a few figures I have copied out in order to remind you. The Prussian war was sharp, short, and decisive. The total number, killed, wounded, and missing, was 127,000; died by sickness alone, 12,000. In the Crimean War, the French would not give their number of dead, but 309,000 men were sent to the Crimea from France, of which number 200,000 entered the hospitals, 50,000 only of that number for wounds. I mention these points to try and urge Mr. Brassey to let these amateur Officers—Naval Artillery Volunteers I find they are called—fall through. They will never be of any advantage, and I hope and trust that the State will not have to hand out money for them, because it will be eventually so much out of the Naval Estimates.

Captain Colomb, R.N.: Mr. Brassey, although he appeals especially to Naval Officers, feels quite as strongly as Naval Officers do, that this question is an imperial question—one which Naval Officers are not likely to view from a broad stand-point—not from the stand-point from which it ought to be thoroughly and clearly viewed. When the lecturer spoke of the Navy not being represented in the House, I could not help thinking as I listened to him, that if we had not naval Members we had, at least, a very fair representative of one in the person of Mr. Brassey. The divergence of naval opinion was adverted to by Mr. Brassey, and was to a certain extent confirmed by my friend Captain Willes. My experience of that divergence is this, that it is a divergence on the surface, and that if you bring two naval men of apparently completely opposite opinions together, and go a little below the surface—a little below the mere words that they happen to utter at the moment, you will find that there is a very much greater consensus of opinion than you would have at first supposed. And I have very good reason to say that, for I was a member of a Committee on a certain subject, where the papers we had before us consisted, in great part, of the reports of two previous Committees on the same subject, and of the witnesses who had been examined, and I may only indicate the general divergence of opinion by saying that, in one of these Committees each member sent in a separate report, and stated that their desire to fulfil the directions given to them was the only point upon which they were unanimous. We dealt with the subject in question, and having spoken to different members of that Committee since, I find that the manner in which it was dealt with, met the views of, I think, the whole of them. I do not think that we must take American experience at all, unless we take it as making for an increase of our naval force. I think if we were to go to the Chancellor of the Exchequer about next October, he would tell us what the result of not having a sufficient naval force might be for us, because, I presume, we should not be in a position to call upon another country to pay over to us three millions for our own neglect. The American commerce, as we all know, entirely disappeared from the seas, simply because she was not prepared for a naval war.

The strength of the first-class Naval Reserve, Mr. Brassey sets at 12,000, and considers it satisfactory, and I understand him further that he would diminish it by 2,000, and that he thinks 10,000 would be enough. Now, I agree with Captain Willes most distinctly and strongly on the point. I understand him to say, that in some way, we must incorporate the mercantile marine; either by transfusing from the Mercantile Marine into the Navy, or from the Navy into the Mercantile Marine. I feel that now most strongly, and I think it has a larger bearing than that which concerns the Navy immediately. I think that we have, in recent events, very clear proof that unless the Government does take some steps towards assisting the Mercantile Marine in the manner suggested by Captain Willes, that great service will go on deteriorating, as we have some reason to fear it is doing now. Mr. Brassey asks, have our own seamen deteriorated? I think we should find, if we took Naval Officers and examined them superficially—as I have stated—that some would say they have, and others would say they have not. But I think if you went a little closer and cross-examined them, they would say, "We never were in so fine a condition as to our seamen in the Navy as we are at this moment—taking the individual seaman." The point as to the Officers of the Reserve, as Captain Willes says, is a very difficult one. I think that carrying out the policy of diminishing the number of Naval Officers who are on the Navy List, and who are, therefore, intimately con-

nected with, and interested in, the Navy, we run some very great risks. I will only give an instance which has come prominently before my mind since I came into this theatre. A little time ago, Colonel Valentine Baker read a paper on "the employment of cavalry" before this Institution. Not only the theatre but even the gallery was filled. There was no room for any outsider to have found his way in in any direction. Now, I should like to know whether "the employment of cavalry" or "the state of the Naval Reserves of England" is the more important question. Again, I should like to know how many Naval Officers on the Active List have been able to attend to hear this great question discussed. And I say that you run that great danger, and it is a very serious danger, by the diminution of the numbers of Naval Officers on the Active Lists that you do not get *numbers* sufficient to put the naval view forward, and that, consequently, the naval view is not heard as it ought to be. We come next to the Coast Volunteers; and I think Mr. Brassey, unless I am very much mistaken, is under a misapprehension as to the chief reason of the unpopularity of the Coast Volunteers. The objection I have always heard alleged against them has been that they were under a peculiar engagement—they were not liable to be called beyond a certain distance from the coast of England. That I have always understood to be the real objection to the force. Far-seeing men argue that in time of war, when you had got men, you could not pledge yourself that you would use them within a certain distance of the coast of England. You might want them anywhere. That, I have understood, was the real objection.

This brings me to another important point which Mr. Brassey has brought forward. I have viewed, with the greatest alarm, the growing feeling in England that our defence is round our coasts. Now, in the old times of our country's history, it was a coast defence certainly that we used, but it was a defence on our enemies coasts, to prevent them leaving their harbours, and that, I am certain as I stand here, is our true policy still.

Then, Mr. Brassey advises that our Coast Volunteers should be increased and our first Reserve diminished, as I have before noticed. If you enter these hardy fishermen; and if you spend money, time, and trouble in training them, and if you engaged that they shall serve on board your ships not at a certain distance from the land, but where you want them, then I agree with Mr. Brassey that you have, in those men, a most valuable force. But if, on the other hand, you are looking to train them merely for coast defence, I should be afraid. I had the pleasure, the other day, through the kindness of Mr. Brassey, of seeing his Volunteers; and I am not prepared to agree with Captain Willes in his remarks upon that force, because, although the force may be small, and may not be capable of doing much, it always would be small in any case, and though it might cost a little money, yet in these times, I do think that however and wherever you can get the public really interested in the Navy, he who does it, performs a really good office, and for that reason I hope that Mr. Brassey will succeed in extending his Volunteers.

Captain J. C. R. Colomb, late R.M.A.: With your permission, Sir, I should like to make one or two remarks. Mr. Brassey invited discussion upon a number of points, which were not only of importance to the Navy, but to the country at large. First of all, Mr. Brassey invites discussion with regard to the required strength of our Naval Reserves. Next to the efficiency of the Reserves: There can hardly be a more important question than the number of the Reserves this country requires to meet the emergencies of war. Now, the strength of your reserve must have some relation to the strength of your force, and again, the strength of your force must have a very intimate relation to the strength of the force against which it may have to contend. Taking that principle, in order to form a rough estimate, and to raise, if possible, or to continue a discussion, which is of great importance, and with the view of fixing the necessary number of the reserves, I should wish to say, that there are two classes of war which materially influence the strength of the Reserve. The one is an European maritime war, which would lead to the actions being fought in armoured vessels. A war of European Powers would call certain forces into operation—forces and fleets which would take part in actions as a combined force. But, if you take the case of an American war, the circumstances are totally changed. Let us take the first case—a war with European Powers—and see what forces can be brought to bear against us. I think it will appear that the number of guns in ironclads that

could be brought to bear upon this country, amounts to about 1,800. Therefore, taking that as a rough estimate 1,800 guns may possibly be opposed against you, by a combination of all the civilized Powers of Europe; you may fairly suppose that 1,800 of our guns would be a fair match, and, therefore, basing an estimate on the number of men required for the guns, you get at something like a possible calculation for the number of men you probably would require for manning the Fleet to oppose a European combination. But if, as it is not at all within reasonable probability that the whole of Europe is going to be arrayed against us, you take, two-thirds of this total number of guns, you will find that the number of men required for our ironclad Fleet would be 40,000. (Mr. Brassey: How many of the 40,000 need be *bonâ fide* seamen?) That of course is another matter. I was merely speaking of the numerical strength. I will come to the question of the quality of the Reserve after I have spoken of the numbers. Passing on from that to an American war I doubt whether it is in the range of possibility to decide how many men we should want. Having the present American Fleet as a guide it appears that we should have to launch about 20,000 men—that is, calculating 20 per gun, and gun for gun with America. But there is no doubt that is a false estimate, because the number of vessels that would be launched as "Alabama's" and war vessels is a thing we cannot calculate.

Now, with regard to the quality of the Reserve. From some experience on board ship, and with military forces regular and irregular on shore, I confess that I regard, with considerable apprehension, the numerical question of the reserves taking too prominent a place. I think it is a matter of very serious importance that discipline should be the thing to which we should, first of all, look. Now, where men are only brought together for a short period of training, it is very hard to get discipline. Drill is not discipline; the training of men at a gun is, no doubt valuable and good, but you must not compare a man only so trained with a man who has been for years under discipline. This was shown very forcibly at the siege of Paris. In Paris, for three months, they were training gunners night and day. No opportunity was neglected to create an efficient force of Artillery to hold the forts. After three months of training, night and day, the hour at last came when the training was to be put to the test, and those who remember the account in the *Times* of the fall of Fort Avron, will agree with me that it is discipline and discipline only, that will enable gunners, however well trained to stand the brunt of war. If I am not detaining you too long I should just like to read a passage from this account, and I would beg you to bear it in mind when considering the question of our reserves: "A deserter who has come in says, that when the projectiles from the "German artillery began to fall on Fort Avron there was dreadful consternation "among the new artillerymen who served the guns." *These were men who had three months' training night and day.* "No good artilleryman would have given up "such a position after one day's firing. I repeat that it is this giving in after a few "hours' firing surprised the Germans, and can only be accounted for by the stuff of "which the gunners were made, or perhaps it would be fairer to say by the fact that "they had not been sufficiently trained." Now, they must have known their duty after three months, but they had not the discipline; and I call your attention to that statement for the sake of showing that the mere fact of providing training at short periods may make a man handy at a gun—may make him know his duty at a gun—but unless you have had a sufficiently long opportunity for instilling into that man habits of discipline, in the hour of your great distress you may find that although he is a trained man, he is not *all* the man you want to fulfil the duties required of him. I was exceedingly glad when I came into this room, knowing what the lecture was to be, to see that map; for that map shows what the Navy has got to do. Mr. Brassey, in his lecture, passed away from our home ports to others, which are really of very little less importance to us; namely, the colonial ports. And, therefore, I merely wished to remark that I trust that any scheme having for its object the strengthening of our naval force, whether it be offensive or defensive, whether for action on the open sea, or for the defence of our harbours, may never be limited to the few ports of the United Kingdom.

With regard to the remark which fell from Captain Willes respecting the Officers, and with regard to the speech of the Secretary to the Admiralty (in reply to Mr. Brassey's very able speech upon Naval Reserves), in which he spoke about the

difficulty there was in educating seamen, because there was no room on board ships for them, I wish to make just one remark. Captain Willes said, the difficulty was, that you do not know how to employ your Officers in time of peace, and the difficulty that the Secretary to the Admiralty pointed out was that there was no room on board ship for them. Now, of course, one is very apt to get off a subject on to one's hobby; but I totally deny that that is a state of things which it is necessary should exist, or that it is a system which will last. You are paying 150,000*l* a-year for the half-pay of Naval Officers whom you cannot employ, because there is no room for them on board ship. You are also, and I beg particularly to draw the lecturer's attention to this before the question of amateur Officers is taken up at all, you are also paying 150,000*l*. a-year to another class of Officers (Marines), whom you are putting on board ship and educating for the purpose of being put on board ship, and when you put them on board ship, you cannot employ them; you have nothing for them to do. Consequently, you are blocking up your ships, which ought to be training schools for all the men and Officers that you should employ. You are blocking up and are filling every place with men, who could be more useful elsewhere. I speak with regard to the Marine force, that is the Marine Artillery and the Infantry. You will find my words are quite correct, that while you are complaining that you have not room on board your ships for educating your seamen, you are filling your sea-going ships with a large proportion of men who never can be seamen —whom it is never intended should be seamen—and whose services are more wanted elsewhere. The same remark will apply to the Officers.

Mr. Stirling Lacon: May I be allowed, Sir, to offer one or two observations, and I do so with great diffidence in your presence. One great advantage of this Institution is that persons who are not connected with either Service are enabled to express their views, and therefore opinions may be obtained upon the different questions that are raised here from other than a professional or an official point of view. This question of the Naval Reserves has been exhaustively treated in this Institution on a former occasion by Captain Gardiner, from which time I took a very great interest in it, and the subject has never been mooted in the House of Commons without my making a point of being there to hear it discussed. One thing that has astonished me very much has been this; that while the Report of the Committee of 1860 stated that there never would be a solution of this question without an harmonious action between the Navy and the Merchant Service, I have, every time that I have been in the House of Commons, found the First Lord of the Admiralty on one side of the House, and Mr. Graves representing the opinion of the Merchant Service on the other side at variance, and that there has been as much hostility and antagonism upon this question, as though the Navy and the Mercantile Marine belonged to two rival nations, the Minister stating that it is not the duty of the Government in any way to provide sailors for the Mercantile Marine. What did I gather on the different occasions when I had the privilege of being present in the House of Commons? That the Navy are educating the raw material at a cost of 60*l*. per boy, and Mr. Graves on the other hand stating that boys are brought up in the training ships for the Merchant Service at a cost of 19*l*. per boy. I will mention the reason presently why this great cost has been incurred by the Navy, but I think I have the authority of Sir Rodney Mundy for saying that the raw material which you are now raising for the Navy, although it was necessary to adopt independent means for the Navy 20 years ago, is too expensive and too good at the present time. We know that men cannot become sailors unless they go to sea at a very early age, and we know also that in the Merchant Service no person can get to sea now-a-days unless he can pull and haul. The qualification for the Naval Reserve is that a man shall have been five years at sea; but being five years at sea no more makes a man a sailor than a donkey standing in a stable for five years will make him a horse. What do you do with these men when you have enlisted them in the Reserve? Why, you give them 6*l*. retaining money and 4*l*. training money every year, and this goes on year after year until they are eligible for a pension. Now, I hope we may not go to war for many years to come, but if we should, then all this expense will have been incurred without corresponding advantage to the country. What has Mr. Goschen said in the House of Commons with regard to the question of pensions? He said that the question of pensions was a most important

and a most serious one; that it was an accumulating evil, and one that demands the serious consideration of the House and of the country. He promised to lay a statement as to this accumulative burden of pensions before Parliament, but I am not aware that such promise has ever been realized. Now we will go back 20 years to the time when the navigation laws were repealed and free trade came into operation and the apprenticeship system was abolished. This latter was done in spite of very strong representations that were made at the time to the Government. I believe Mr. Labouchere was the Minister. Many of the Mercantile Marine thought it a most suicidal act, but the Government which had carried the questions of the repeal of the navigation laws and of free trade, could not say to the shipowners "you shall carry apprentices," although I believe a boy on board a ship ought to be looked upon as necessary a part of the ship as a mainmast or an anchor. An apprentice law, to be of any service to the country, must be a compulsory apprentice law; it must be obligatory upon all, for if it is made obligatory on all it would be no hardship on any one, because all would be served alike, and the same argument would apply as to the competition with foreigners, because foreigners are obliged equally to bring up their own boys. But since we have abolished the apprentice law, the boys of this country, who would take to the sea like ducks to the water, have not been able to get to sea at all. When Captain Gardiner read his paper, the sense of a great number of persons of different classes in Liverpool and elsewhere had been taken with regard to this question; and at that time, four years ago, I believe 60 per cent. of the persons whose opinions were asked, were in favour of an apprentice law, and 40 per cent. were in favour of training ships; all thinking that something must be done. Since then four years have elapsed, and events progress very fast. In the face of the loss of the "Atlantic," and what is every day happening, the supply of seamen is no longer a question exclusively for the shipowners and the Navy, but it is also a question for the public, and I believe the public will demand that independently of the question of the reserves and the defence of the country, some measures shall be taken with regard to the supply of seamen for the Merchant Service. I do not believe we shall have such a sentiment from the Government again, as that the Government have nothing to do with providing sailors for the country because merchant ships are the ships in which in these days of locomotion almost every one of us, at some time or other, is obliged to travel. The Royal Commission may decide what is proper and what is not proper as regards building. They may decide what is proper and what is not proper as regards loading, and what is proper and what is not proper as regards manning, but they cannot provide sailors, for sailors take some years to make. Four years ago I thought it would be desirable to subsidize the Merchant Service in order to get back the system of apprenticeship, but I believe now the whole of the Merchant Service are in favour of an apprentice law. If that be so, see how that simplifies this question of the Reserve; after a boy has served five years in the Merchant Service he might serve two years in a training ship connected with the Navy where he would learn habits of discipline and obedience—and a few of such men in each Merchant Ship would act favorably upon the rest of the crew. The Navy might take as many as they required for their own purpose, and the rest might go and earn their livelihood for the remainder of their days in the Merchant Service without the necessity for pensions, or further expense to the country. By this means you would have a large body of trained men*—all trained—under the age of 20 who would come forward at war wages, and serve their country if they were required.

Vice-Admiral the Hon. CHARLES ELLIOT: There have been some depreciatory remarks made upon the Naval Reserve; and having had three years' inspection of great part of it, it is right to give my own experience on the subject. In the first instance, when the force was first established, they probably enlisted them rather unscrupulously, and there were probably a good many men who were not seamen.

* Nelson asked for 120,000 men. Mr. Brassey puts the reserves at 10,000 men, and Admiral Tarleton at 6,000 men. If the same man is returned on the strength both of the Militia, and the Royal Naval Reserve—it is but reasonably to ask whether in the event of war, he will be looked upon as a soldier, or a sailor.—W.S.L.

The force was got up rather too quickly. But latterly—I should say from my own experience—the reverse has been rather the case—that they have been rather over-strict. I had three years' inspection of a number of men, those that happened to be in drill at the time along all the east and part of the west coast, and those that I saw, were remarkably fine men, and as far as discipline was concerned—we cannot say what they might be on board ship—they appeared perfectly disciplined. I only found one exception where things were not very well done. With regard to their standard, I may mention one circumstance, that we were so particular as to the standard of height, for the men that we entered from the Merchant Service, that the minimum of our height was above the average height of the whole of our seamen brought up from picked boys. They were remarkably tall fine men. I may also say, with regard to the Coast Volunteers, they are very fine men. They are of a different class, and, with different treatment, I think we might have most useful men from the very men who have been in our Coast Volunteers, but the treatment is not satisfactory.

Captain Goodenough, R.N.: My object in rising is to give a short statement of the numbers of men in the Naval Reserves of other countries, and I shall not violate confidence or state a word that is not in printed or published papers when I give a short sketch of them. As we all know, the most complete and most interesting Naval Reserve which exists in Europe, is that of France which has now existed some 250 years, has always been progressive, and as to whose discipline there has never been a single hitch or doubt. The numbers under that Naval Reserve Act of France are at this moment about 172,000 men,—that includes all the men of all ages, from 18 to 50. I do not mean to say that the whole of these men are efficient, but we may get some idea of the number of efficient men when we know that for some years past there have been about 15,000 men afloat, and about 7,000 men in reserve in barracks, and that you may say that there are in reserve double the number of drilled men that are on actual pay, making a total of about 65,000 or 66,000 men between the ages of 20 and 36. They are not all born seamen, but the great majority are brought up to the sea from the age of 14 or 15—fishermen, and men who have been to sea in various capacities. Some 4,000 every year are drafted to the French Navy from the conscription of the Army. Those men are specially drilled to the exercise of small Arms. A fair number of these afterwards enter the *Inscription Maritime,* which confers very great advantages on all who consent to join it, and who reside at naval ports. I should be quite unable to enter into the conditions of the French Naval Reserve Act, but it is to be found in the French printed regulations, and is of the utmost interest. At all times in the history of the English Navy those who have sought to work out some registration of British seamen have been those who have had some experience of the French service, beginning with Lieutenant St. Lo, who was in prison in France and who when he returned to England made his remarks in a pamphlet on the registration of seamen, entirely derived from the French system.

There are about 80,000 seafaring men in North Germany. Those seafearing men are described as being not merely foreign going seamen but as fishermen and also men who work about the docks and harbours. No large proportion of those men have passed through the naval service, but some 3,000 have been enrolled for some time past, and, at the present moment there are some 5,000 serving. You may always say when you speak of any German force, that the force enrolled under their organic law, has twice the number of its representatives in reserve; so that if there have been 5,000 enrolled in the German Navy there are 15,000 men, if all reserves are called out, without calling up the *See-wehr* or *See-sturm.*

In Austria very much the same number of men and very much the same law exists. In Italy something of a similar law exists, but there it does not suit so well, because they have an immense maritime population. In Austria and Germany it does suit the population: their system of compulsory service taking in every class. But in Italy it does not suit it the least in the world. They have a maritime population of 225,000, chiefly fishermen, but of whom a great number man those Genoese barques of which so many are employed in the carrying trade, and some few steamers trading to all parts of the world. The Italian law states that the seamen are divided into classes, each class being composed of men who reach the age of 18,

during a single year. As there are a very large number of men, the Navy enrols only, say, one-fifth of a class, but when the Reserves are called up for actual service, the law obliges the Government to take the whole of the class; therefore it has for every drilled man, to take four undrilled men before it can touch the men of the other classes. I mention this to show, that an organic law for the compulsory service of seamen does not suit all countries; it suits admirably a small maritime population, but it is not adapted to a large maritime population. The French system is the one which alone, as far as I know, suits every class in France admirably, for there their Navy is largely in excess of the protection required by their Merchant Service.

Reverting to Mr. Brassey's excellent paper, I think the most valuable suggestion which he has made, and the one most likely to bear fruit is, that with reference to an Inspector-in-chief of the Naval Reserve. Wherever that idea had its birth, and it has now been spoken of largely for some time, this is the first place in which it has had public expression, unless my memory fails me, and Mr. Brassey may have already spoken of it in the House of Commons. I think that from the date of the appointment of an Inspector-in-chief of Naval Reserves, you may expect to see first of all the exact facts publicly reported and spoken of as to the condition of Naval Reserves, then an exact comparison between the men in one part of the country and in another, and finally the exact wants of the Naval Reserve made known as to Officers. (Mr. Brassey: The comparison between year and year.) And also the comparison between year and year. There are many other points I should like to touch upon, but as the hour is so late I will merely advert to one, viz., as to the numbers of men who are likely to be required, and I think the speakers generally have seemed rather satisfied with the present number of men whom we can call upon for foreign service. I am by no means so: I look upon 10,000 men as a very small flea-bite, particularly when you consider that that is not a number that you will be able to lay your hand on at once. You will probably be able to lay your hand immediately on 2,000, and within a little time afterwards on another thousand. (A Visitor: You will get them abroad.) But perhaps they will not be at places where your ships are, so that I look upon that as a very small flea-bite. During the war between France and Germany the largest number of men the French had called out at any one time, was over 72,000; it is true that a large number of those were on shore, but that does not afford any argument, and if we look at the commencement of a war we see the immense advantage which a large Reserve gives. The French were able (although they did not use it) within 21 days, to fit out a fleet of 10 or 11 ironclads and to have them ready to send to the Baltic. Everybody knows we could not do that. A point on which Mr. Brassey asked for our opinion, is that of the condition of merchant seamen. I am sorry to say I am not in a position to judge of the comparative aptitude and comparative worth of our merchant seamen at the present day; but I take it that it is a case something like that of the horses which has been spoken of without due knowledge, and that there exist at the present moment as large a number of good English seamen as there ever existed, but that the number has not kept pace with the wants of the Merchant Service, it has not kept pace with the rapid increase of our Mercantile Marine. For instance Mr. Brassey said that some 8,000 prime men are employed in yachts; that is a very much larger number of men than were ever employed in former years, and a great number of those men who are the very best seamen, have been withdrawn from the Merchant Service. (Mr. Brassey: Temporarily.) For an increasing time every year; for I observe that yachts are fitted out earlier and sail later every year. The whole question of this training of merchant seamen is a question very closely bound up with that of technical training in other trades and professions. We heard a great deal a few years ago about the great want of technical training in all trades and professions. The trade of seamen is essentially one which requires technical training. In former years, where each ship had a large complement compared to what she has now, and where there was a large proportion of boys entered, the training of boys for their profession as seamen went on insensibly. Shippers got men as they wanted them, and therefore people did not care to inquire how they got them. But at the present day nobody wants boys; they cannot be economically employed as hands, and therefore it is absolutely necessary that we should have a system of technical training which will prepare lads for their work as men afloat. Whether they are to get that tech-

nical training by the combination of merchants and local boards to found schools, or whether they are to get it by the assistance of the State, I do not pretend to say, but there is no doubt the State must interest itself in the matter; and one way in which it can do so is, by compelling the proper manning of merchant ships. We know that a great many are exceedingly ill manned, and we frequently hear of ships being manned by men of different countries, who cannot understand each other. That is a matter in which the State can interfere by declaring that the ship shall be efficiently manned, and that the crew shall be inspected by a proper person before the ship goes to sea. That again would compel the local authorities and local boards to institute a system of training under which men could be brought up, so that ships might not be stopped by an officer of the central Government from proceeding to sea for want of men. There are three classes of Reserve of which Mr. Brassey has spoken, and when speaking of those for coast defence, I must say I have always thought fishermen and that class of men could be made most useful. We should want to defend our coast, not so much by guns probably, although there we should require a certain number of men, but to a larger extent by obstructions and torpedoes, and in that case we should at once have to fall back on the assistance of fishermen, who know the set of the tides, the creeks and estuaries, and are perfect hands in the management of boats. I must say I regret very much indeed that, in consequence of the better state of preparation of the Engineer Officers and men, for the questions of the day continually submitted to them, the defence of the coast of this country has fallen into the hands of the Engineers. It ought to have fallen into the hands of the Navy, but simply from the want of preparation of Naval Officers in those technical trifles, such as the use of electric torpedoes, the whole thing has fallen into the hands of Engineers instead of into naval hands. In Germany, where they have studied this point very closely, because they look upon their defence in a future war as being almost mainly confined to the defence of their coast; they had before their war with France a sort of combined corps. There also the Navy was not duly prepared; they had no Naval Officers who had the amount of technical knowledge to enable them to lay down and fight with torpedoes, and therefore they were obliged to have a certain number of Engineer Officers, to whom they attached a number of seamen, with Naval Officers to command them, who worked under them and carried out a certain number of experiments. At the conclusion of the war the whole thing was altered. They had then found out that the grand difficulty in torpedo warfare and coast defence by torpedoes and obstructions, was the management of boats; no amount of technical knowledge of torpedoes could enable sappers or Engineer Officers to manage boats; only a seaman's experience was of any good there. Therefore they altered their whole system, and at this moment the defence of the coast of Germany is confided to a Torpedo-Abtheilung of the Naval Reserve, which numbers 300 men, always employed, and about 1,000 men when the Reserves are called up. Therefore I think that portion of our Naval Reserve could be very well employed in this manner.

Rear-Admiral Lord FREDERICK KERR: With reference to one force which has been spoken of, viz., the Naval Coast Volunteers, I am convinced, as far as my experience of them for some years goes, that they are the worst stick the country ever attempted to lean upon. When a reserve of the Navy was talked about a great effort was made to enrol the fishermen and that class of men. Men living anywhere near the coast—and they were not very strictly confined to that—were enrolled in that corps, and at the time I got the command of a division of them, there certainly was not a sailor amongst the hundreds of men in that corps; they were chiefly miners, and that class of men who if you put them in a boat, and sent them across Milford Haven would have been sea sick. From the urgency which was used to make the corps complete, and to get up the numbers, the question of efficiency was totally disregarded, and the country paid for that corps when they were not of the slightest use, in fact they were worse than no use because they were held out as something good when they were utterly useless. They were amphibious animals to a certain extent, but they were not sea-going, for on one occasion I remember a man being claimed by three Militia regiments, besides the corps in which he served as a volunteer; he arranged the time so that he went from one to the other and received his four bounties and four rates of pay. There was another man who recommended himself as having lived on

the water all his life. I found out that his father kept a mill and that the water ran under the house, so he said he had lived on the water all his life. I believe in Scotland it is better done, and if the Officers in England had been sufficiently resolute in the first instance to withstand the pressure, when the pressure was put upon them, the result would have been different. You know that some Officers will give way when an external pressure is brought to bear upon them, if they see they are carrying out the wishes of their superiors, although the strict letter of the law may be against them. I should be very sorry for Mr. Brassey to go away without having some little "*pat on the back*" with regard to the corps as to which he has taken so very much trouble, and which I had the pleasure of seeing drilled the other day. As far as the efficiency went, it was extraordinary, and considering the very short amount of drill that they have had, I think their efficiency must be put down to the superior intelligence of the men in the force. They came to their work determined to do it in a voluntary spirit, and they have reached an efficiency which is very encouraging and very satisfactory. I suspect the numbers of that corps would never be very large, but being a purely Volunteer Corps they deserve encouragement of every sort, and I am sure if they choose to give their time and efficiency for the service of the country, free of expense, nobody can blame them. We might go a little further. When the Volunteers were instituted, the object was to carry out such operations as have been mentioned—not only coast defence and the manning of forts—but that gunboats should be manned and small vessels, so that the country might be made a sort of wasp's nest with small vessels round the coast manned by our fishermen in times of war. These are the sort of men you want—not miners. With regard to the men Mr. Brassey has taken so very much interest in, I mentioned to him the other day, that there are men anxious to join a corps of the same sort. The present one is an elective corps, but I have had applications from men who have served for years in the Navy, who, after having gone through their apprenticeship, and learned that most essential portion of it—discipline on service (somebody suggested teaching discipline afterwards, but I say rather of the two, teach them discipline first and drill afterwards); these men are anxious to join a Naval Coast Defence Corps to be placed on the same footing as the Volunteers on shore—that is, merely to have their drill, and Army accoutrements, and the same capitation grant given to them. My informants said they knew hundreds of men in London who would be willing to join such a corps, and who were very anxious to do it. If the Government, however, say that they have reserves enough, the thing is at an end; but should they want more, there are a number of such men who will, if you give them the same encouragement that you give to the shore Volunteers, come forward and form a small but efficient force to assist you in defending the country.

Lieutenant Craufurd: Captain Willes mentioned the Reserve and the retired Officers, and said, that they might possibly be called out. Now, Sir, I wish to plead that some opportunity should be given to them for preserving their qualifications, either by allowing them to go for a cruise in the first Reserve or Coast Guard ships, or in some way to keep up their professional qualifications. I think a great many young Officers, who have retired from private motives, would be very glad to keep up their professional qualifications, and do what they could in time of necessity.*

Mr. Brassey: I have but few words to say in reply. Indeed at this time of night it would be most improper that we should prolong the proceedings. With regard to the point on which I was very anxious to have the opinions of Naval Officers, namely, as to whether or not the Reserve we at present have, is sufficient, I have heard, with the deepest interest, the opinions given to us by Captain Willes, Captain Goodenough, Captain Colomb, and other Officers, and I take it that I must accept it as the opinion of all those Officers that our present Reserve of 12,000 seamen, is scarcely adequate to meet the demands of a naval war. If that be the fair representation of the state of opinion in the Navy, then I arrive at the conclusion that there is a good ground for recommending the adoption

* There are nearly 80 retired Lieutenants under 10 years' seniority, might not a large proportion of these Officers be willing to devote some time to keeping up their professional qualifications in case the country should require their services on an emergency?

of some of those suggestions which were made by the Commission of 1859, with a view of assisting in the training of seamen to serve in time of peace in the Mercantile Marine, but who were to be available for the Naval Service in time of war. I have, on various occasions, endeavoured to promote the adoption of those means, but those whose duty it has been to defend the policy of the Admiralty, have asserted that there was no necessity for a larger Reserve than we have at present. But if I mayventure to proceed, on some future occasion, confident in the belief that it is desirable to have a larger Reserve, I shall have a basis of operations which will give me a greater opportunity of promoting those measures which have been recommended by the Royal Commission. With regard to the number of Officers, if the system of half-pay, under which we undoubtedly have a great number of Naval Officers in reserve, is not in itself objectionable, then, I think we may dismiss from our minds any feeling of anxiety as to the reserve of Officers. The present system does, undoubtedly, furnish a great number of Officers, but a large number of gallant gentlemen are necessarily on half-pay. Then with regard to the Coast Volunteers. I have been taken to task very severely, for saying that there had been a certain laxity in the enrolment of unfit persons in that force. But I find from the opinions expressed this evening that I had not made a very great mistake. I am glad to find gallant Officers think that in our fishing population which is very numerous, there are elements of strength for the country in the hour of need; and I am quite sure that if the proper means be taken, the fishermen could be induced to join the Reserve. They are, no doubt, a slow and somewhat suspicious body. I take it if you wanted to attract a large number of those fine hardy Scotch fishermen into the Navy, it would be a very imprudent thing to send an Officer born in Hampshire to enlist them. A good Scotch name would be capital introduction to the fishermen of Scotland. They are a class of men whose confidence is not very easily won; but I do not despair of being able to attract the fishermen to join the Coast Volunteers. I am very grateful to the gallant Officers, for the kind terms in which they have spoken of my lecture, and I shall always take the deepest interest in the Royal Navy.

The CHAIRMAN: I am sure you will all wish me to return our cordial thanks to Mr. Brassey for the interesting lecture he has given us to-night, and for the great interest he has taken in this subject. There are one or two remarks I should like to make, without following him through the whole of his lecture, more especially as Captain Colomb has taken the wind out of my sails, and has anticipated me in a good deal of what I should have said. With regard, first of all, to the Officers, I find that there are at the present moment 278 Officers of the Royal Naval Reserve on our Navy List. Striking off 78 of these as Officers, who are honorary or disabled by age, and who might not be prepared to come forward, yet 200 of these would, I think, be exceedingly valuable for manning our improvised men-of-war (such as the Peninsular and Oriental line of steamers), with a gun mounted for the protection of commerce, and also in commanding transports. Last year, the Admiralty obtained an Order in Council for the enrolment of 200 midshipmen for the Royal Naval Reserve, to be taken from the "Worcester" and the "Conway." These young gentlemen are very much socially of the same status as ourselves; of good education; and no doubt they will be a very valuable supplement to the Officers of the Navy. Then, with regard to the Royal Naval Reserve itself, I had to go into the figures, a short time ago, on the Naval Estimates, and I found, taking our peace Navy at 19,000 blue jackets, we could maintain that force by the entry of about 3,000 boys, so that we are self-supporting as far as the peace Navy is concerned, and in the event of a war, we should then have to fall back on our reserves. We have, at this moment, something under 12,000 men in the Royal Naval Reserve. These are men who certainly are, whatever may be said by some speakers in this room, the *élite* of the mercantile marine. They are men who must have been five years at sea and one year an able seaman, and I appeal to Admiral Elliot and also to Admiral Keppel and Sir William Codrington, who have inspected the drill ships, to say whether they have not been surprised at the efficiency of these men at drill, and the ready way in which they manned the guns. I believe that they are reliable. I may estimate that the numbers that we shall be able to supplement the peace Navy by, would be 6,000, that is estimating that one half would be abroad, and those men with the Coast Guard. The Naval Pensioners and the remaining Coast Volunteers would man all

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our ships with blue jackets that we could possibly provide for them, and there would be then 6,000 men in reserve. I do not mean to say the number of our ships ought not to be very much increased on the outbreak of hostilities, but we should have enough men to start with, and then other men of the Reserve coming home would form a further Reserve to fall back upon. With regard to the Coast Volunteers, and the strictures passed upon them, I certainly had recommended that they should be gradually let drop. As they were constituted, the Act of Parliament, in the first instance, ran, " seafaring men and others." That gave great latitude to the Officers who were very anxious to show as many as they could on their lists. In the next place, the Act ran that they were not to be taken more than 100 leagues from the land. The Duke of Somerset, when in office, had that altered, and they may be taken now any distance from the land; but, however, the class of men you wanted to enrol did not come forward. Those were the fishermen whom Mr. Brassey spoke of very rightly as being most valuable people for coast defence and the manning of gunboats; but these men would not give up their occupations to go on board ship, to live for 30 days amongst people of different habits to their own. Therefore, they do not come forward, and we have only got the longshore men such as Lord Frederic Kerr has described. I quite agree with Mr. Brassey that if we could organize the plan of having gunboats to go to the great fishing centres we should be able to obtain the services of these men, and with a drill of, say a week at a time, the men coming off in the morning and going ashore in the evening, you would be able to obtain as many men as you required to release your seamen for distant service, and to perform all the duties you would require on the coast and in the estuaries.

With regard to the Royal Naval Artillery Volunteers, I should like to say a few words. Mr. Brassey has taken great interest in the formation of this corps, and I think that they do deserve great praise and encouragement for the way in which they have thrown themselves into this movement. It is the first time that there has been any movement towards the Navy of a purely voluntary character. The Volunteers hitherto are all paid and well paid, but these men had given up their time, and at very great personal inconvenience have been on board the drill ship in the West India Docks, drilling through the winter in the evenings after their work has been over. I, myself, can testify that they showed very great proficiency in drill for the short time they were instructed, and the instructors tell me they never had people to instruct who showed so much intelligence or zeal in attempting to acquire a knowledge of the drill. The great difficulty with regard to them, if they are to be encouraged, is to give them facilities for training. Of course if, as Mr. Brassey says, he can obtain the formation at different ports, of different corps, it would be necessary to provide gunboats for their training, and I do not know exactly where the gunboats are to come from. I am afraid we should find it very difficult to assist them in that way.

With regard to the Reserves in the Colonies, it is true that there are a number of sea-faring men, fishermen, there, who would be available for their coast defence; but I think we may safely leave it to the Colonies themselves to protect their own hearths and homes. They would have power to legislate for themselves, and a little encouragement from this country, is all that they would require.

I will not detain you any longer, but will only say that these discussions are extremely valuable, because they are the only way of discovering our weak points, as the test of the efficiency of the Reserve can only be put in practice when the safety of the country is endangered.

LECTURE.

Friday, May 2nd, 1873.

General SIR WILLIAM J. CODRINGTON, G.C.B., &c.,
in the Chair.

THE AUSTRIAN ARMY.

By Lieutenant C. E. H. Vincent, F.R.G.S., Royal Welsh Fusiliers.

It is not without considerable diffidence, Mr. Chairman and Gentlemen, that I presume to come here this afternoon, humbly to bring to your notice the manner in which Austria has grappled with that most terrible problem of recent years—Army Reorganisation. I feel, too, that especial apology is due on account of the time. The morrow of the day on which that mighty empire inaugurates that which tends so potently to the promotion of peaceful industry and the development of inventive genius, would seem to be the date least fitted on which to bring under review her resources for war and the destruction of mankind.

This morning's telegrams inform us that the Reigning Chief of the Imperial House of Hapsburg, in company with the illustrious heir to the throne of England, opened little better than twenty-four hours since the International Exhibition of Arts and Industries at Vienna. Many, and I doubt not many of you, gentlemen, will seize the opportunity of visiting one of the most enchanting of European capitals. All will admire her palaces and her theatres; her promenades and her streets; her municipal institutions and her environs; and above all the country which has successfully brought all peoples, nations, and languages into one arena of commercial emulation and of social gathering. Not a few, however, there will be who, in witnessing all the pomp and luxury, all the riches and apparent prosperity around them, will think of the terrible trials Austria has passed through, and how, within the living memory of the youngest historical student, a hostile army held the fair city within its grasp. They will then turn their attention to the existing means to prevent the renewal of such a catastrophe. Let me, with your permission, endeavour to assist them in their investigations. But to you, gentlemen, I cannot give better advice than that you should yourselves become acquainted with the Austrian Army, that you should visit the Military Institutions, and the vast camp of Brück. You will not be unrewarded for your trouble;

for apart from the instruction and information derivable, you will meet with the rarest courtesy, the profusest hospitality and friendship. . .

Recent events have brought about such a fever of Army Reorganisation throughout the length and breadth of either hemisphere, that those who, a few years ago, were thoroughly versed in the military details of a country, now find themselves entirely at fault respecting the formation of its army. The subject, truly, has become in a manner distasteful and monotonous, but it is impossible not to feel some curiosity as to the manner in which the leading members of the world of nations have construed and applied the principles of modern military might, whose sole efficacy has been so terribly demonstrated. These principles emanated from the sagacity and forethought of two earnest representatives Scharnhorst and Gneisenau, of a country driven to the verge of ruin and despair by the continued victories of the enemy she has lately worsted in so unprecedented a manner. . . . .

In respect to Austria, the practical application of the study was no easy task, beset as she was with the germs of internal discontent, and resounding with the angry clamour of hostile factions. The military yoke had never been light, yet ill-success had continually attended the hardships and privations of the Army. The people were in little humour to suffer further encroachments on their liberty, and it was absolutely necessary to begin by pacifying the more or less just murmurings of the heterogeneous races composing the monarchy. How this was done in detail, little concerns the subject in hand, but it is known how the all-important loyalty of the Hungarians was secured by permitting them to crown and hail a King in the person of the Kaiser und König Franz Josef I, who granted them their long-wished-for separate Diet and Administration.

No time was now lost, and on the 4th of December, 1868, the Imperial signature was affixed to the retrospective law introducing the system of obligatory personal service for every male subject of the Austrian Crown.

To work out the details of the new system, Field Marshal Lieutenant Baron von Kühn, the then Minister of War, devoted himself with an indefatigable zeal, supported by talent of the highest order. But how difficult and tedious was the labour, how long it must remain apparently unproductive of result, is fully illustrated by the half century of uninterrupted peace and prosperity which the Northern Model required to develop the system and to arrive at perfection in its working.

Those of you who are, and I imagine there are few present who are not intimately acquainted with the organisation of the North German Army, may perhaps be astonished at Baron von Kühn's faithful adherence to that military prototype. This, however, is only on the surface of things, and it is hard for us to dive far below the surface, in the single hour to which the lecturer in this theatre is wisely confined. The admirably compiled and voluminous pages on the "Heerwesen der "K. K. Armée," will furnish ample material for novel investigation, and will show forth how many excellent provisions emanated solely from the Viennese Ministry. . . . . However I must plunge at once *in medias res*.

The Military Force of Austria is composed of—

The Standing Army,
The Reserve,
The Landwehr,
And the Landsturm.

The latter element, though, meaning simply a *levée en masse* of the entire male population for the last struggle in defence of hearth and home, having neither arms nor even theoretical organisation, exists but in name, even it is to be hoped to the most distant future.

The total liability to military (or naval) service extends over twelve years, commencing from the 1st of January of the year succeeding the 20th birthday to the termination of the 32nd year.

This period is thus apportioned—

3	years to the	Standing Army,
7	,, ,,	Reserve,
2	,, ,,	Landwehr.
12		

Service in the Landwehr is, however, variable; for, under certain social conditions, which I will presently enumerate, as well as the inhabitants of the three privileged communities of Trieste, Cattaro, and Ragusa (who, under the old system, were entirely free), individuals are permitted to fulfil the whole of their liability in that force, having received regular training with the Army for at least two months.

The effective numerical strength of the Standing Army, Reserve, and Landwehr, amounts to about 1,100,000 men, of which about $\frac{8}{11}$ths are contributed by the first two categories, the Standing Army and Reserve, to which Hungary furnishes a quota of nearly 330,000.

His Imperial, Royal, and Apostolic Majesty the Emperor Francis I, is at the supreme head of the Austrian Army, which he governs through the Ministry of War, and the Inspector-General, His Imperial Highness the Archduke Albrecht (the author of the celebrated pamphlet "Responsibility in War"), who is answerable for the military efficiency. The War Ministry is divided into three main sections—

The Personal,
The Military and Technical,
The Economical.

These are again subdivided into various departments.

A Chief of the Staff and five Inspectors-General of Artillery, of Engineers, of Cavalry, of Transport, and of Remounts, are appointed to assist the Minister.

The Chief of the Staff superintends the distribution of the Staff in all its practical and scientific departments, administers the Pioneer Regiment, and generally supervises all military education. . . . .

Each of the other officers is responsible for his branch, and forms the organ of communication with the Government. He superintends all the technical military schools, and to him are made the confidential reports.

There are 292 officers employed in the War Ministry at Vienna, exclusive of permanent engineer, artillery, and transport committees. . . . .

The most perfect department, perhaps, in the Ministry, is that for the collection of military intelligence and information. It can hardly be far behind the Berlin General Stab in the extent of its researches. It is divided into four sections, viz.:—

1. For interior topography.
2. For external topography.
3. For matters connected with railways, steam-packets, and telegraphs.
4. For the collection of information concerning foreign armies.

The officers employed in these four sections are sought for throughout every branch of the standing army, reserve, and landwehr, and their appointment is governed by no pedantic laws of routine and precedent which limit the area of choice, and consequently detract from power and strength, where they are especially needed.

Austria, inclusive of Hungary, is divided into seventeen military districts, the head-quarters of which lie at—

1. Vienna, for Lower Austria (6 brigades of infantry, 1 of cavalry, and 1 local brigade).
2. Linz, for Upper Austria and Salzburg (1 brigade of infantry, 1 of cavalry).
3. Brünn, for Moravia and Silesia (2 brigades of infantry, 1 of cavalry).
4. Graz, for Steirermark, Kärnten, and Krain (2 brigades of infantry, 1 of cavalry).
5. Triest, for the town of Triest, Istria, Görz, and Gradiska (2 brigades of infantry).
6. Innsbruck, for the Tyrol and Vorarlberg (2 brigades of infantry).
7. Prague, for Bohemia (6 brigades of infantry, 2 of cavalry, and 1 local).
8. Lemberg, for the Eastern portion of Galicia (2 brigades of infantry, 2 of cavalry, and 1 local).
9. Krakau, for the Western portion of Galicia (2 brigades of infantry, 1 of cavalry).
10. Zara, for Dalmatia (2 brigades of infantry).
11. Pest Ofen (3 brigades of infantry, 3 of cavalry, and 1 local).
12. Presburg (2 brigades of infantry, 3 of cavalry).
13. Kaschau (2 brigades of infantry).
14. Temesvar (2 brigades of infantry, 3 of cavalry).
15. Hermannstadt (2 brigades of infantry, 1 of cavalry).
16. Peterwardein, for the military frontiers (2 brigades of frontier troops).
17. Agram, for the Croatian and Slavonian military frontiers (2 brigades of infantry, 2 of frontier troops).

At the head of each district is a General Officer, who is responsible for all the military administration of his command, which is divided into two distinct branches—

(1.) The purely military and technical.
(2.) The economical and control.

Every male subject of the Austrian Crown incurs, as I said before, the liability to military service. Exemption is only obtainable from physical deficiencies, in which case the exemptee has to pay a pecuniary indemnity to the Military Invalid Fund, and under the following social conditions, viz.:—

1. Being the only son and support of a helpless father or widowed mother.

2. After the death of a father, being the only grandson and support of an infirm grandfather or widowed grandmother.

3. Being the only support of helpless relations.

All service by a substitute, or exemption by purchase, is abolished. Those who have already got off by these means are for ever free; but for all others the law is retrospective, and service is required of them according to their age.

Certain social conditions further enable men to pass at once into the landwehr, having received two months' instruction in a regular regiment, viz.:—

Being the possessor of inherited property sufficiently extensive to support a family of five persons, and not larger than will maintain four such families.

Being a divinity student, a candidate for a professorship, or a national schoolmastership. . . . .

As in Prussia, the system of one year volunteers is in force, in order that the civil professions may not be deteriorated by the military exigencies. Youths of good character and education can qualify themselves in this manner for commissions in the reserve and landwehr, at the same time that they become freed from regular service in time of peace. The educational standard for the Einjährige Freiwillige is estimated by the passing of a special examination or the attainment of a certain place in the classes of a Government school. They are permitted to serve in the branch they select, whether it be combatant or non-combatant, with the regiment, and in the garrison also of their choice. The year may be any one of those between the 17th and 25th birthdays. At the termination of the year's training, which embraces all the duties of the various ranks, the volunteers are submitted to a searching theoretical and practical examination. Those that become reserve officers are liable to be called out for three trainings of not longer duration than four weeks each. At the proper age, the reserve officers pass into the landwehr. The expenses of the year's voluntary service fall entirely on the individual, even to quarters, except in a few isolated cases, when they are defrayed by the public, who in return demand higher qualifications, and evidence to show that the volunteer has no means of his own.

Ere I speak of the peculiarities of the several arms of the Austrian Army, it behoves me, gentlemen, first to direct your attention to the all important system of officering the whole. Austria does not find the same facility as Prussia, and happily ourselves, in procuring the best material for filling the commissioned ranks. It is a disagreeable, yet in-

controvertible fact, that the best blood which alone can lead plebeian ranks to victory, somewhat shirks a profession which bears the stigma, more by its misfortune than its fault of possessing "la routine de la défaite." Not all the deeds of signal valour which the Austrian Army adds each campaign to its gallant history, can thoroughly dissipate the keen sarcasm of the remark for which, I believe, a Hohenzollern Prince is answerable. Moreover, the severe mental and physical work and incessant examinations which the Austrian Government now exacts from her Officers, shakes off all but the most zealous.

In the standard of theoretical professional knowledge, Austria surpasses even Prussia. Practical tests, too, bar every stage of advancement.

The military schools are very numerous, and the education therein given is excellent. Cadets, who have been trained at the public cost, have to remain ten years in active service from the date of their exit from the academy, those who have paid half rates for seven years, and those who have paid full terms, for four years. . . . . But the preparation for a commission may be regimental instead of academical, and in this manner the path is open to any non-commissioned Officer of good character and antecedents, and of sufficient attainments. Many Austrian Officers—some might say too many—rise from the ranks. However, the regimental training is preferred to the academical by many, even of the most gentle blood. . . . .

After the aspirant has practically learnt every duty of the private and non-commissioned Officer, he attends the school which is established at the head-quarters of every division. Here he goes through a course of eleven months, followed by an examination. If this be successfully passed, he returns to the corps, and performs the duty of an Officer, though still uncommissioned. In course of time, when a vacancy occurs, and his proper turn has arrived, he receives his commission, subject to the unanimous approval of the Officers of the regiment as to his social worthiness. This consent of the Offizier Korps to receive their comrade elect, is never dispensed with except in the case of a cadet.

In spite, however, of this wholesome provision, the camaraderie for which our own and the Prussian Services are so remarkable, is somewhat wanting in default of the opportunities of social intercourse. The pay is too small to permit the establishment of messes, and few possess private resources. Besides this, the repeated transfer of Officers from one regiment and garrison to another on promotion, loosens friendships and lessens *esprit de corps*, which are such universally acknowledged elements of success.

Promotion goes right through the army, arm by arm, and rank by rank. It is by seniority and non-seniority. The former depends on the confidential reports giving clear testimony of the individual's efficiency. The latter method is followed every sixth step below field rank, and every fourth step above it. The candidates for non-seniority promotion are submitted to a very severe theoretical and practical test. These examinations are held biennially, and the successful competitors

are promoted in their numerical order on the final list. The expenses of candidates for non-seniority promotion are paid the first time of trial, but if they then fail, and obtain permission again to try their chance, they must defray them themselves.

This method of promotion would appear to merit some attention, for while it holds out a reward for the deserving and industrious, rapid advancement, by its means, can never be supposed to have connection with opportunity, interest, and protection. It must work equally fairly for the son of the Minister and for the promoted non-commissioned Officer.

Special qualifications, even if others are somewhat in defect, are always taken into account in considering the worthiness of a candidate.

For all purposes of promotion, cadets are counted as officers.

There is no special examination for promotion below field rank, but to pass from Captain to Major requires so vast a display of intellectual and military power, that many retire before so formidable an obstacle, thus clearing the way for true ability. Candidates for field rank must naturally be the Senior Captains of regiments. To prepare for the examination, it is optional with them to study for eleven months at the special school for each arm in Vienna. The practical test consists in being placed, suddenly and without previous warning, in charge of a force consisting of not less than three battalions of infantry, two squadrons of cavalry, and half a battery of artillery, with orders to carry out some general idea, given by the examining officer. The theoretical knowledge lies in all that appertains to military efficiency.

The minimum of time to be spent in a junior position before promotion is as follows:—

To Captain, four years as a subaltern.

To Major, four years as a Captain.

To Colonel, three years as a Field Officer.

After three years' service, aspirants to the Staff are allowed to enter the Staff College or Kriegs Schule. The course of study lasts two years, and comprises much the same subjects as are taught in other colleges of a like nature, but to the notable exclusion of mathematics in any shape or form. . . .

An Officer can leave the Standing Army at his own request after one year's service, but he must enter the Reserve or Landwehr, unless he has attained the limit of the 32nd year of age. . . . .

Foreigners are no longer admitted into the Austrian Service so freely as formerly. Now, they must obtain the formal authorization of their Governments, produce certificates as to character and probity, pass through every grade of the military hierarchy, and, like born Austrians, speak fluently one of the numerous dialects of the empire besides German, before they are eligible for promotion. At home, then, I take it they will find it more comfortable to act upon the trite saying, "Dulce et decorum est pro patriâ mori."

I have shown how easy it is to pass from the non-commissioned to the commissioned ranks, but the Austrian Government does not ignore

the necessity of having experienced and reliable "Unteroffiziere." A limited number are therefore permitted to re-engage with the consent of their Commanding Officers for a further period of service after the termination of the first three years. The re-engagement dates from the first of January, and is never for more than one year at a time. Every re-engaged non-commissioned Officer receives a daily addition of 15 kreutzers to his pay, and a gratuity of 60 florins at the end of the first year if he then takes his discharge; 120 at the end of the second; 190 florins after three extra years; 260 after four; and 1,260 florins, or £100, after twelve, besides the certainty of a comfortable and honourable, if not very lucrative, Government situation.

The Standing Army

must now be considered. It naturally forms the military training school of the country.

The tactical units are the division and the brigade. A division consists of two or three brigades. An infantry brigade is composed of two regiments of the Line and one of Rifles. A cavalry brigade is made up of two or three regiments, to which is usually attached a battalion of Rifles.

The Standing Army is divided into 24 divisions, consecutively numbered. The 21st, 22nd, and 23rd divisions are composed of Frontier troops.

These 24 divisions contain 71 brigades, 52 of infantry and 19 of cavalry. The brigades are usually known by the names of their Commanders. . . . . A Field Marshal Lieutenant, corresponding to a Lieutenant-General, commands a division as a rule, and a Major-General a brigade.

The Infantry

of the Austrian Army possesses no Corps of Guards, except a small body of Gentlemen-at-Arms, who guard the person of the Sovereign, and are termed the Imperial and Royal Guards.

The infantry of the Line consists of 80 regiments, corresponding to the 80 recruiting districts into which the Austro-Hungarian Monarchy is divided. Each district has its regiment of infantry, of cavalry, and battery of artillery to supply.

The regiments are numbered from 1 to 80, and are known by their number and the name of their honorary proprietor.

A regiment is commanded by a Colonel or Lieutenant-Colonel. It consists of five field battalions of four companies each, and one reserve battalion of five companies.

The battalion is commanded by a Lieutenant-Colonel or Major. . . . . The companies of the field battalions are numbered consecutively from 1 to 20, those of the reserve battalion from 1 to 5.

The stations of the first three battalions of a regiment are those which are most suitable for the public service; those of the fourth and fifth battalions, of which the cadres only are maintained in time of peace, are invariably within the recruiting district for the purpose of

the periodical manœuvres of the reserve. The cadre of the reserve battalion is stationed at the head-quarter town of the district. To it are usually attached those persons who have to undergo eight weeks' training prior to enrolment in the Landwehr. . . . . The strength of a battalion on the peace footing is 14 Officers and 372 men; and of a regiment 89 Officers and 1,434 men.

A company on the peace-footing has three Officers and 95 non-commissioned Officers and men. . . . . The mobilisation of the Standing Army is effected by calling in the men on furlough and the reserve. The complement of Officers is likewise made up, and further by the commissioning of cadets if necessary.

A battalion on the war establishment numbers 18 Officers and 934 men; a regiment 133 Officers and 5,935 men, of whom 17 Officers and 350 men are non-combatant. . . . . A company on the war strength, is composed of 4 Officers and 236 non-commissioned Officers and men, to it then are further added four pioneers, and three bearers of the wounded. . . . . The rifle troops consist of one rifle regiment and 33 independent field battalions. The Tyrolese riflemen, whose fame has endured through long ages, are organised in seven battalions of four companies each, seven reserve companies, and one additional battalion, the cadre only of which is maintained in time of peace.

The Austrian infantry is now armed with the "Werndl" breech-loading rifle, a somewhat heavy weapon and clumsy to the eye, though very formidable in competent hands. The ammunition pouches of the privates contain 72 rounds; of the non-commissioned Officers 24. . . . . There was a time when the smart white tunics of the Austrian infantry were well known in every *salon* in Europe, and the human masses of snowy white captivated foreign critics no less than they offered a fatal mark for hostile bullets in the field. Now, however, the white has been superseded by a bluish-grey, and belts of un-tanned leather have taken the place of pipeclayed straps. Hungarian regiments are still allowed to wear their peculiar close-fitting blue pantaloon terminating in the boot.

Far be it from me to presume to say that Austria has gone too far in her honest desire to sacrifice effect to utility, but I have heard men of experience and observation remark in Vienna, that the slouching gait of the sentries, and their ill-worn uniform, shows that a new feeling of disregard of personal appearance has sprung up in the Army. One of the most illustrious of contemporary celebrities, who, now alas, lies asleep in a temporary resting place not many miles from this Institution, publicly warned armies against the fostering of so pernicious a feeling from the palace-prison to which he had been chiefly driven by the excessive encouragement of it, and its concomitant evils. Yet the danger may only lie in the limit imposed, rather than in the feeling itself, for there could be no more unsoldierlike sight to our insular eyes than the Prussian Guardsman rolling backwards and forwards on sentry go, and steadily ignoring such a thing as the manual exercise in the manipulation of his rifle; yet what finer troops could there be in the field?

The Cavalry

of Austria, and yet more so of Hungary, is world-renowned. Aye, gentlemen, many a square has been broken, many an advance covered, many a retreat gloriously defended, by those splendid horsemen. Although it is stated that they have lost something of their old prestige, have fallen somewhat from their pinnacle of perfection since the change in the war functions of that arm, we may be sure that many an additional proof of valour will be shown by them to any future enemies of his Imperial Majesty.

The cavalry of the Austrian Army consists of 41 regiments, whereof 14 are Dragoons, 14 Hussars, and 13 Lancers.

Each regiment is composed of six field squadrons, numbered 1 to 6, one depôt squadron for the training of recruits and remounts, and one reserve squadron.

Three squadrons form a regimental division or wing.

The strength of a squadron on the peace footing, is 5 Officers, 1 Officer's substitute, and 130 non-commissioned Officers and men, whereof 16 are dismounted; on the war establishment, 165 non-commissioned Officers and men, of which 20 are dismounted. . . . A cavalry regiment takes the field with about 30 Officers and 870 sabres. The reserve squadron is usually detached for escort and orderly duty, the protection of baggage, &c., by which means the six field squadrons are kept together.

The total combatant strength of the Austrian cavalry is about 36,000 men, armed with the sabre, a breech-loading carbine and pistol, and the lancers with a lance. The pouches contain 30 carbine and 15 pistol rounds.

The training of the Austrian cavalry is now based upon the latest and most approved principles. Outpost and reconnaissance duties are ceaselessly studied.

Each regiment draws its recruits, who are selected for their previous association with horses, from the one or two infantry recruiting districts to which it is assigned. The preliminary training of recruits begins in the autumn at the depôt squadron, from whence in the spring they are drafted to the field squadrons.

Re-engagement year by year is considerably encouraged in the cavalry, but the number of re-engaged men must not exceed 90 per regiment.

But, gentlemen, at the present juncture, when such earnest attention is being directed to the supposed failing supply of horses in this kingdom, and serious apprehensions enter into the most non-alarmist minds of the difficulty that would be experienced in meeting any extensive demand either for offensive or defensive purposes, I venture to think you will feel more interest in the remounting, than in the recruiting system of the Austrian cavalry. I will, therefore, pass on to it at once, although a new law on the subject is at present under discussion at Vienna.

I cannot, however, omit first to direct your notice to a very admirable institution in the Austrian cavalry. The mounted arms are now pushed

so far in advance of the main force, that it is above all things desirable for them to possess in themselves all the mechanical skill they may chance to require. For this purpose, the fourth section of the sixth squadron of regiments is composed of artisans, who, besides their regular training, are especially instructed in practical engineering, in the laying and repairing of communications, and more particularly of railroads.

The remounts are supplied in part from the Government breeding establishments, of which there exist no less than twelve, and in part by the purchase of the horses at a predefined price, which have been bred therein and sold to agriculturists and others, on the understanding of the call that may possibly be made upon them. It is well known what excellent English blood has passed into these Austrian haras, and it is, indeed, high time to impose some restraint on foreign countries profiting so much more than ourselves by British equine resources. . . . . After the remounts for the current year have been furnished, the residue four-year-old stock is, I believe, sold by public auction. No cavalry regiment is suffered to remount more than 12 per cent. per annum of the mounted men. The remounts are distributed so that two-fifths of the horses are from 14·3 to 15·1 high, and three-fifths 15·2 and 3, or over.

Subaltern officers are mounted at the public cost. Staff Officers, Captains, and one year volunteers have to provide their own horses.

The Artillery

is the arm we will now briefly consider. Its splendid history you cannot ignore, and its skilful handling and glorious devotion on the fatal day of Königgrätz, will still be fresh in your minds.

The Austrian artillery consists of twelve regiments of field, and twelve battalions of garrison artillery. The former are designated by their consecutive numbers, and the names of their proprietors. The latter simply by their numbers. . . . . A field artillery regiment is commanded by a Colonel, and consists of—

4 four-pounder foot batteries.
3 ,, horse batteries.
5 eight-pounder foot batteries.
The cadre of a depôt battery, and
The cadres of five ammunition columns.

In war, a thirteenth battery can be added to the regiment, and the calling-in of the men on furlough and in the reserve, brings the batteries up to their full strength, *i.e.*, from the aggregate total per regiment of 75 officers, 1,415 men, and 532 horses, to 97 officers, 3,558 men, and 2,795 horses. In time of peace, the batteries are distributed throughout the monarchy, in the manner most beneficial to the public service. In the field, each *corps d'armée* of three divisions of infantry is allotted—

4 four-pounder foot batteries.
2 ,, horse ,,
6 eight-pounder foot ,,

Together with the first four of the artillery train columns of a regiment.

A cavalry division has two four-pounder horse batteries attached to it.

A battalion of garrison artillery consists of the battalion staff and six companies. To the 9th battalion of garrison artillery three mountain batteries and (likewise one each to the 11th and 12th battalions) are attached . . . . The artillery recruits are obtained in the same way as those for the infantry and cavalry, from specially assigned recruiting districts. They are generally those of a superior intellectual class. Mountain batteries seek men who are inhabitants of hilly districts.

The horses are furnished by the remount establishments in the proportion of one-third 15·3 high and over, one-third 15·2, and one-third 15·1.

The Engineers

of the Austrian Army consist of two regiments of five battalions each, with four active and eight reserve companies, and one depôt battalion of five companies. There are, consequently, 25 companies in each regiment, which, commanded by a Colonel, has in peace a complement of—

118 officers and 2,736 men.

The Transport Service

of the Austrian Army is conducted by the Military Transport Corps, which consists of 36 field squadrons, 22 of which on mobilisation are assigned to the infantry divisions, five to the cavalry, four to army corps head-quarters, and two to general head-quarters.

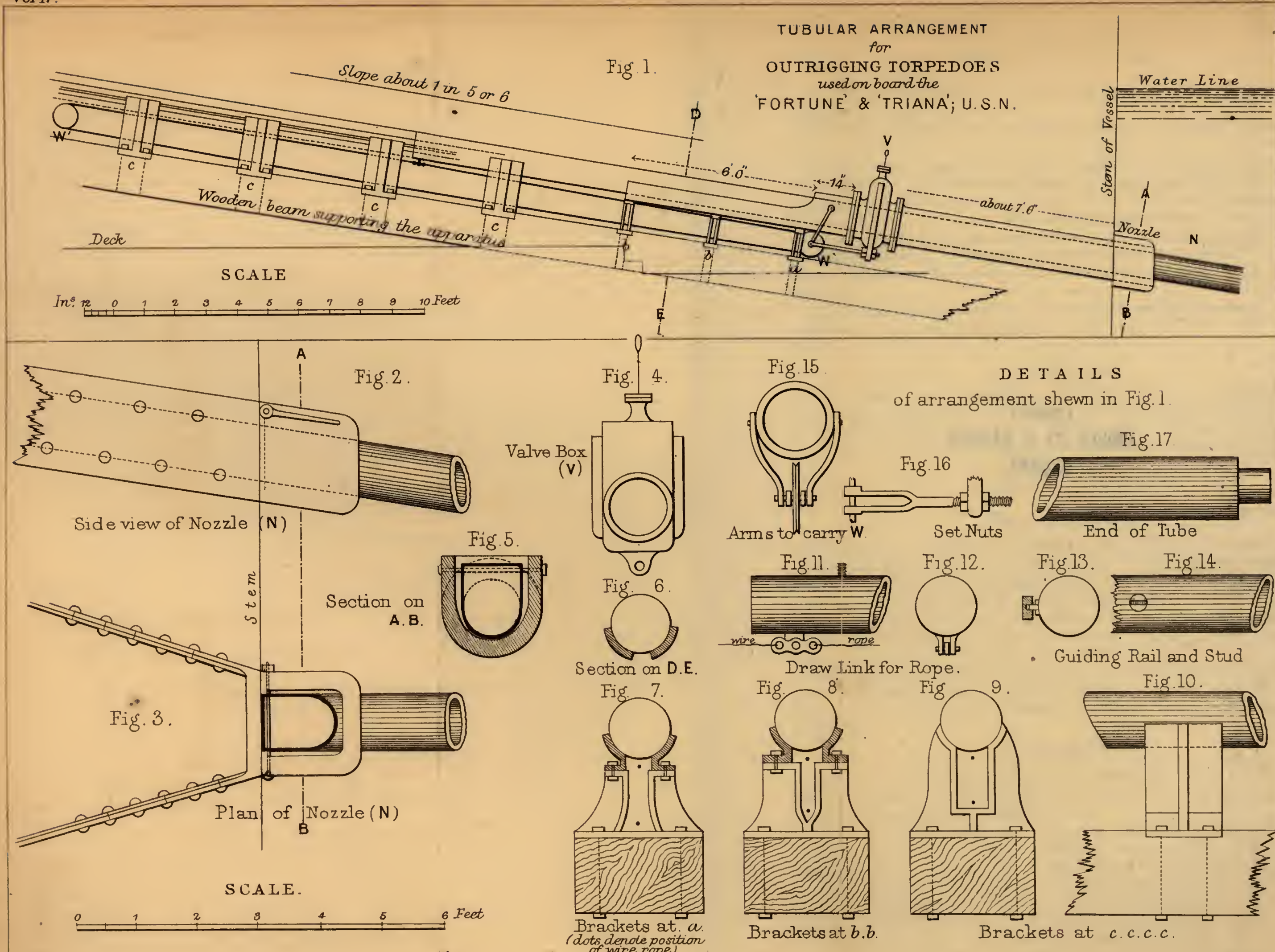
The strength of the several squadrons varies, according to the nature of its duties, from 260 to 360 officers and men, with from 330 to 430 horses, and about 100 waggons and carts.

This system of transport appears to be less calculated to attain that great desideratum of having the baggage well up with the troops, which is achieved by the Russian and now by our own regimental methods.

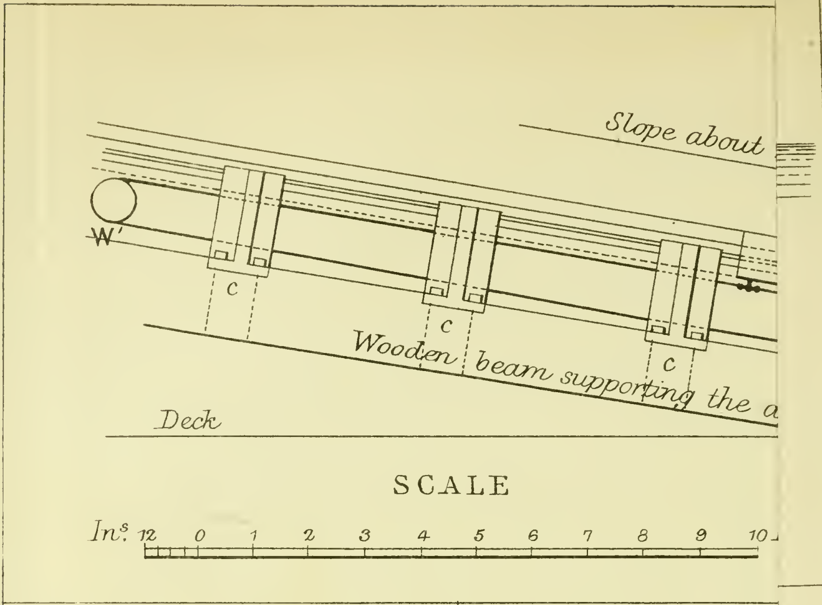
The Hospital Corps

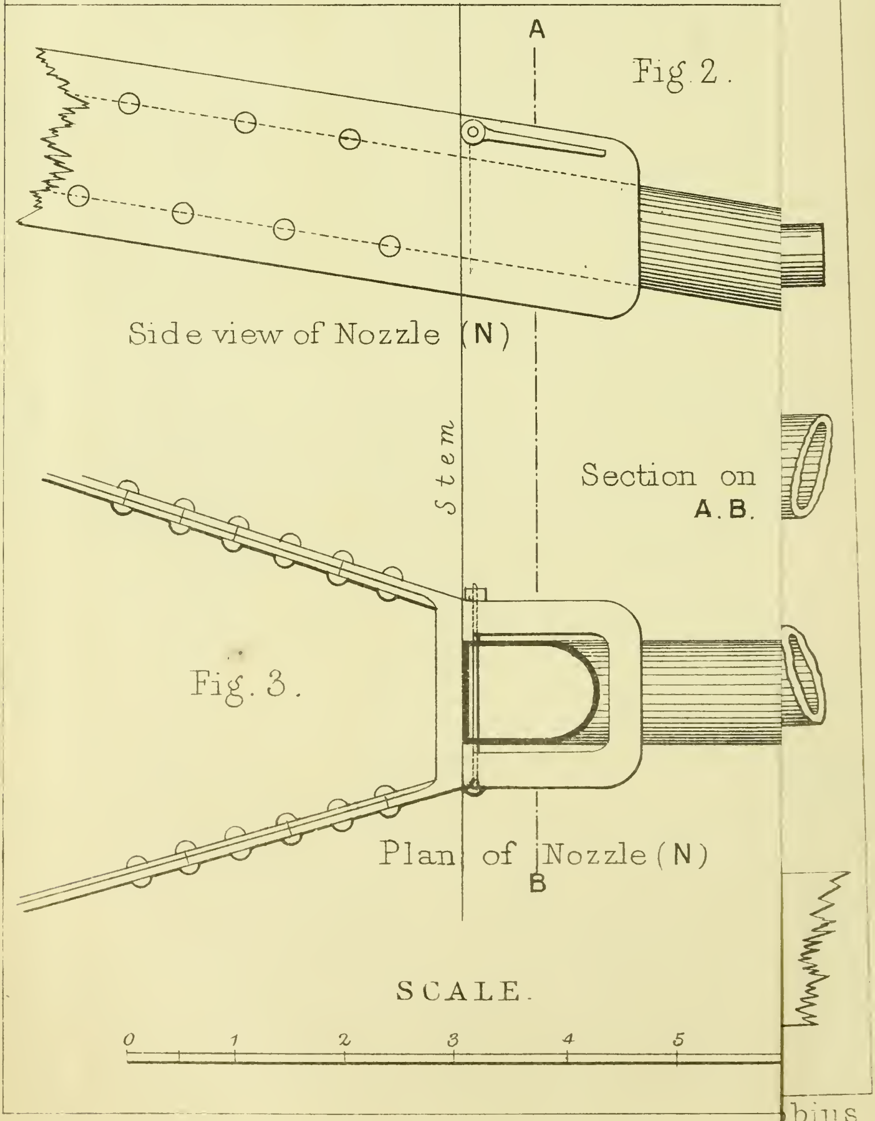
consists of 23 divisions. Their duties are solely in the hospitals; that all-important duty of bearing the wounded from the field being performed regimentally by trained men.

Time will not permit me to make additional demands on your patience by referring to the detailed organization of the reserve and landwehr. The former is subjected to periodical trainings, not exceeding three of four weeks each, in the course of its seven years' service. The minute the word goes forth for mobilisation,—should such unhappily become necessary,—it will be united with the Standing Army. The landwehr has no annual training, but in that force, where youths and veterans meet, the field army has a powerful support in numbers, no less than in quality.


TUBULAR ARRANGEMENT
for
OUTRIGGING TORPEDOES
used on board the
'FORTUNE' & 'TRIANA'; U.S.N.
Fig. 1.
Slope about 1 in 5 or 6
Wooden beam supporting the apparatus
Deck
6' 0"
14"
about 7' 6"
Water Line
Stem of Vessel
Nozzle
SCALE
In.s 12 0 1 2 3 4 5 6 7 8 9 10 Feet
DETAILS
of arrangement shewn in Fig. 1
Fig. 2.
Side view of Nozzle (N)
Fig. 3.
Plan of Nozzle (N)
Stem
Fig. 4.
Valve Box (V)
Fig. 5.
Section on A.B.
Fig. 6.
Section on D.E.
Fig. 15
Arms to carry W.
Fig. 16
Set Nuts
Fig. 17
End of Tube
Fig. 11.
wire rope
Fig. 12.
Draw Link for Rope.
Fig. 13.
Fig. 14.
Guiding Rail and Stud
Fig. 7.
Brackets at a.
(dots denote position of wire rope)
Fig. 8.
Brackets at b.b.
Fig. 9.
Fig. 10.
Brackets at c.c.c.c.
SCALE.
0 1 2 3 4 5 6 Feet

J. Jobbins


Slope about
W'
c
c
c
Wooden beam supporting the a
Deck
SCALE
Ins. 12 0 1 2 3 4 5 6 7 8 9 10


A
Fig. 2.
Side view of Nozzle (N)
Stem
Section on
A.B.
Fig. 3.
Plan of Nozzle (N)
B
SCALE.
0 1 2 3 4 5

bins

I am free, gentlemen, to admit that my account of the Austrian Army has been far from complete; yet, if it induce any one of you to enter into closer acquaintance with a body with which our service is knit by the bonds of mutual esteem, my object will have been fully attained. I have now but to express my sincere acknowledgements to you, Sir, for the honour you have done me in presiding here to-day, and to you, gentlemen, for the consideration with which you have been pleased to listen to my narrative.

DESCRIPTION OF THE TORPEDO BOATS "FORTUNE" AND "TRIANA," UNITED STATES' NAVY.

By Lieut. J. Townsend Bucknill, R.E.

These vessels were employed as tugs during the civil war, and were lying at the Washington Navy Yard in January, 1872. One of them, the "Fortune," had then been converted into a torpedo boat, and was in commission, but the other was undergoing a refit and alteration, so as to convert her into a similar torpedo vessel.

The navy yards of the United States are all open to the public, and, although I could gain very little information respecting these torpedo boats, I was enabled, by a hurried inspection of the "Triana," to take the following details, the *approximate* accuracy of which can be relied upon:

Size, 170 to 180 tons.
Length over all, 130 feet.
Beam, about 25 feet.
Draught, from 8 to 9 feet.
Engine 125 H.P. single vertical cylinder, direct acting.
Speed, 7 knots.
Burns 11 tons of coal in 24 hours.
Carries 95 tons.
Rig, fore and aft schooner, pole-masted.
Spread of canvas unknown, but small.
Freeboard, about 5 feet.
Bulwarks, about 3 feet.
Top-hamper, as usual, with American tugs.

The deck of the "Triana" had been removed, and she was being strengthened throughout, but more especially in those portions near the bow.

About 4 or 5 feet below the normal water-line, an iron nozzle was fixed in line with the stem or fore-foot by means of two ears, which were riveted to the sides of the vessel. This nozzle, which projected in front of the stem, was bored out to form a hole a little over 10 inches in diameter, and in the top of the nozzle a large U-shaped aperture was made, into which an iron door could swing when the torpedo was pushed from the interior of the vessel, Figs. (5), (2), (3). This door, in its normal

position, hung by its own weight vertically across the opening, which led into the interior of the vessel by a large brass pipe (10 inches diameter internally) that was attached to the inner side of the nozzle. This pipe, as well as the nozzle, had an inclination upwards towards the stern of about 1 in 6, or 1 in 5, and at a distance of, apparently, some 7 or 8 feet from the stem, the pipe terminated in a flange by which it was attached by screw bolts to a valve box, as shown in figs. (4), (1), containing a valve to be worked by hand. To the inner side of the valve-box another brass pipe was attached by screw bolts, and the pipe was only cylindrical for a distance of 12 or 14 inches, after which the upper half was entirely cut away, see fig. (1), and a slot made in the lower portion, as shown in fig. (6). The segmental portions were supported on three brackets (a) (b) (b), figs. (1), (7), (8). The bracket at (a) was made in two separate pieces, so as to give room for the motion of a wheel (w) (12″ diameter), grooved to carry a $1\frac{1}{2}''$ wire rope. The brackets (b) (b) were provided with a deep central slot, so that the wire rope could work through them, see fig. (8). Behind this arrangement were four larger cast-iron brackets, placed at central intervals of about 4 or 5 feet. Upon these, and in the brass tube before-mentioned, see figs. (1), (9), (10), slid the torpedo outrigger, which consisted of a cast-iron tube some 23 feet long, $7\frac{3}{4}''$ to 8″ internal diameter left rough, and having an external diameter of 10″, obtained by accurate turning in a lathe. This tube weighs about one ton. The outer end that is projected in front of the vessel and carries the torpedo was reduced for a length of about one foot, to a diameter of 8″ or 9″, and was cast solid for 5″ or 6″ at the extremity, and a small hole, about $\frac{3}{4}''$ diameter, was bored centrally, through which the electric wires for the firing arrangement were to be led. The tube was to be run in and out by the wire rope before-mentioned. The rope was in two pieces, and the ends of each attached to a link that keyed to two small ears cast on the bottom of the tube at its inner extremity, figs. (11), (12). The remainder of each rope was coiled on the right and left side respectively of a grooved drum (9 grooves) about 20″ diameter; thus, when one rope was coiled in, the other was slacked out, and *vice versâ*. The drum was carried on suitable brackets fixed to the end of the wooden beam, and was turned by a cog-wheel of like diameter (72 cogs) gearing into a smaller wheel (24 cogs) driven by two handles worked by men standing on either side of the beam. On one side of the drum was fixed a pawl and ratchet. To the inner end of the tube an iron guide $\frac{1}{2}'' \times 1\frac{1}{2}''$ was studded; this engaged in a groove $\frac{1}{2}'' \times \frac{1}{2}''$ cut in the side of a rail bolted to the brackets and brass piece, see figs. (13), (14), (1), and the tube was thus prevented from turning as it was run in and out.

About 16″ from the inner end of the tube, a 1″ screw plug was fixed in the top, it projected about $2\frac{1}{2}$ or 3 inches; its use I could not discover. See fig. (11).

Should the wire rope slacken by stretching it could be taughtened up by the arrangement shown in figs. (1), (15), (16). The axle of the wheel (w) was suspended by two hanging arms pivoted on the brass pipe just inside the valve box, and a forked arm engaged the axle

inside these arms. This forked arm terminated in a $\frac{3}{4}''$ rod threaded at its extremity to receive two nuts. The rod passed through a lug cast on the bottom of the valve box, and by altering the set nuts on either side of this lug, the wire rope could be taughtened up or slacked off as required.

I was informed that the torpedo employed was of cast iron, about 4 feet long and 10″ external diameter, and that the charge was contained in an internal copper cylinder. Also, that the torpedo case was attached to the end of the tube by an iron ring fitting on the reduced part of the tube and over the inner end of the case. This ring is destroyed by the explosion of the torpedo, but the tube remains uninjured, the charge being limited to 100 or 120 lbs. of "cannon" gunpowder. I was informed by a high authority, that it was possible to load, run out, fire, and run in, in from three to four minutes, and that the arrangement gave the greatest satisfaction.

In the "Triana" class of torpedo boats, a bulkhead was placed about 42 feet from the bow; behind this, was stowed the coal, and then came another bulkhead, 20 feet behind the first. A powerful steam bilge pump was fixed in the forecastle as an additional precaution. Portions of the engine and boiler were above the water-line and much exposed to shot. The steam was super-heated in a dome surrounding the funnel, at least 10 feet above the deck. To a certain extent these vessels are experimental only, but several vessels (number unknown) of the United States' Navy, ostensibly tug and despatch boats, are in reality torpedo-boats fitted up on the tubular principle described, or on some modification of it. In some, the tube is thrust out by a screw worked by steam power, but the arrangement described was preferred as being the simplest and best.

It is, I think, evident that the Americans have in this apparatus sought as much as possible to minimize the mechanical intricacies, to a certain extent inherent in this class of torpedo, and if the information I received be correct—viz., that several vessels are armed in this manner, it would appear that the Americans are thoroughly satisfied with the arrangement.

One of the first considerations obtained by investigating this apparatus, is that the experiments of a foreign Power have disclosed the fact that it is possible to fire a charge of 100 or 120 lbs. of Mammoth powder or "cannon" powder at the end of a cast-iron tube, of the dimensions given, *without damaging that tube.* Doubtless a very small charge of dynamite, dualin, compressed gun-cotton, or nitroglycerine, would, if detonated in the same position, utterly destroy the cast-iron tube. This fact being digested, the next consideration and question that arises is, whether 100 lbs. of common gunpowder exploded 7 or 8 feet below the surface, and in contact with the outer skin of an ironclad will cause great damage to such a vessel? Another question suggests itself. Could not a similar apparatus be placed inside the stem of our existing ironclads? If so, would not the ramming power of such a vessel be enormously enhanced? But the Americans do not seem as yet to have applied this plan of working a torpedo from the interior of a vessel to any of their frigates, corvettes, or other cruisers; and

I was unable to discover what apparatus they intended to fit or board the three new torpedo-vessels they had commenced the year before last.

The following are some of the advantages obtained by the employment of the tubular arrangement for outrigging-torpedoes that has been described in the foregoing paper:

1. Ease of fixing and working the torpedoes from a position of comparative safety.
2. Quickness of the operation of re-fixing, booming out, &c.
3. Vessel not impeded, or her speed lessened by the apparatus, the tube not being thrust out until just before it is intended to use it.
4. Everything out of sight of the enemy, and the vessel's true character thereby concealed.
5. By the use of the electric, in place of the chemical fuze, danger to friendly vessels is minimized, and accidental explosions from the torpedo striking against any snag or other impediment, prevented. Moreover, the explosion of the torpedo when in actual contact with the enemy's vessel is ensured and the chance of a failure, such as Captain Davidson experienced when he rammed the "Minnesota" with the Confederate torpedo boat "Squib," and which he attributed to the slowness of action of the chemical non-electric fuze allowing the "Squib," to recoil a short distance before the torpedo exploded, is by the use of the electric fuze guarded against; for it is easy to arrange the electrical portion of the apparatus so that the torpedo can be fired either by judgment or by contact, the former being only resorted to when the contact-arrangement fails to perform its functions. I was unable to discover what the electrical arrangements used by the Americans on board the "Triana" class of torpedo vessels, actually were.

In conclusion I would beg to point out that the Americans seem to have paid more attention to the torpedo-apparatus itself than to its protection from an enemy's shot. This consideration has been carefully thought out elsewhere, and we have only to combine in the same craft the tubular arrangements described in the foregoing paper, with the almost shot-proof deck and noiseless engines of other existing and known types of torpedo vessels to obtain a thoroughly trustworthy and efficient class of vessels for use on our coast defences.


MAP
of part of
THE NORTH WEST PROVINCES
AND INDIAN TERRITORY
of the
DOMINION OF CANADA
Shewing the route followed by
COL. ROBERTSON ROSS.
1872.
The exploratory line of the Canada Pacific Railway is shewn thus
English Statute Miles
BRITISH COLUMBIA
VANCOUVER ISLAND
WASHINGTON
MONTANA
LAKE SUPERIOR
International Boundary
Canada Pacific Railway
PROPOSED SITE FOR A MILITARY POST 50 MOUNTED RIFLEMEN
PROPOSED SITE FOR A MILITARY POST & CUSTOM HOUSE 150 MOUNTED RIFLEMEN
FORT HAMILTON REPORTED SITE OF U.S. SMUGGLERS TRADING POST NAMED BY THEM FORT HAMILTON
PROPOSED SITE FOR A MILITARY POST IN SUMMER, 100 MEN FROM FORT GARRY
Blackfoot Indians
Blood Indians
Stone Indians
MANITOBA
WINNIPEGOSIS
Lake Winnipeg
Fort Carlton
Fort Edmonton
Red River
Lake of the Woods
Fort William

Original
Thompson R.

The Journal

OF THE

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REPORT OF A RECONNAISSANCE OF THE NORTH-WEST PROVINCES AND INDIAN TERRITORIES OF THE DOMINION OF CANADA, AND NARRATIVE OF JOURNEY ACROSS THE CONTINENT THROUGH CANADIAN TERRITORY TO BRITISH COLUMBIA AND VANCOUVER ISLAND.

Communicated by Colonel ROBERTSON-ROSS, Commanding the Militia of Canada and Adjutant-General of Militia in 1872.

CHAPTER I.

ON the termination of the annual training of the Militia in the Provinces of Ontario and Quebec, I proceeded from Ottawa in the first instance, *viâ* Lake Superior and the "Dawson Route" to Manitoba, and in accordance with instructions, subsequently crossed the Continent through Canadian territory to the Pacific Coast and Vancouver Island, travelling nearly the whole distance from Fort Garry on horseback.

Leaving Collingwood on the 16th July, in the steamboat for Thunder Bay (Lake Superior), the vessel reached her destination early in the morning of the 22nd, stopping *en route* at the settlements of Owen Sound, Leith, and Killarney, on the shores of Lake Huron, and at Gargantua Bay, Michipicoton Island, and Neepigon, on Lake Superior. Neepigon Bay is a good and safe harbour, and the place itself is probably destined to be of great importance in connection with the Canadian Pacific Railway. On arrival at Prince Arthur's Landing, I found that a considerable and apparently thriving settlement had already sprung up at that place. The population now numbers about 500; many good houses have been erected, and municipal government has been established. Thunder Bay is one of the best and safest harbours on the north shore of Lake Superior, and the surrounding scenery is very beautiful. For want of a proper wharf, considerable inconvenience is experienced, but as the one now in course of construction will be completed shortly, the landing facilities will then be greatly improved and be all that is likely to be required for some time to come Owing to the great mineral resources and the valuable silver and copper mines which exist in this neighbourhood, and from the excellence of its harbour, it may reasonably be expected, that a wealthy and important settlement will ere long be established at Thunder Bay.

From Prince Arthur's Landing I proceeded on the 22nd July, by waggon in one day, to Lake Shebandowan, a distance of about 45 miles, by what may now be fairly considered a good road. All the

streams have been bridged, and a very substantial structure is erected across the Matawan. When this road shall have been gravelled throughout its entire length, which will probably be effected this summer, it will be as good a one as can be desired. The country through which the road passes from Lake Superior to Shebandowan is well wooded and much better suited for settlement than is generally supposed. Although the soil in the immediate neighbourhood of Prince Arthur's Landing is somewhat sandy, the greater part of the country passed through is perfectly well suited for farming and agriculture. At the Matawan River, farming operations had commenced; very fine timothy hay had already been raised at that place, and the growth of the vegetables and cereals which had been but a short time before planted gave excellent promise.

From Lake Shebandowan I proceeded by canoe to the north-west angle of the Lake of the Woods in seven days, a distance of 310 miles, through the chain of inland waters known as the "Dawson Route," towed part of the way by tug steamers. Considerable progress has been made in opening up and improving this line of communication through the dominion to the vast and important territories of the north-west, and I am satisfied that if greater means could have been placed at the disposal of Mr. S. J. Dawson, much greater progress towards completing the work would have been made by that able engineer. The portages have been greatly improved. There were horses or bullocks with carts or waggons on nearly all. In many instances a shorter and better route than that originally followed, has been adopted, and altogether it is now not only a perfectly available and valuable line of communication during the open season, but it is an indispensable work towards the settlement of the country through which it passes.

At Fort Francis two steamboats of considerable size are being built; one has already been launched, and both are expected to be finished early next spring. One of these steamboats is intended for Rainy River and the Lake of the Woods, the other for Rainy Lake. Additional tug-steamers are also to be obtained, so that by next summer it is expected there will be steam power on all the waters. When this is carried out, the journey from Lake Superior to Manitoba through Dominion Territory will be made comfortably in four or five days, and the transport of passengers, freight, waggons, and horses by the "Dawson Route," effected without difficulty.

For the passage of troops, during the summer season, there is now no difficulty. In October last a detachment of 215 soldiers with two light field guns were conveyed in 25 days from Collingwood, in Ontario, to Fort Garry, in the Province of Manitoba; and by next summer I consider there would probably be no great difficulty in conveying, if required, both cavalry and artillery, as well as infantry, in considerable numbers by the "Dawson Route."

The country along the banks of Rainy Lake and Rainy River is well wooded with valuable timber, extremely picturesque, and still better suited for settlement than the country between Lakes Superior and Shebandowan. The lakes and rivers teem with fish, and self-

sustaining settlements could be readily established there with advantage. From most careful enquiries it appears that the number of Indians occupying the country along the line of the "Dawson Route," and who belong to the Ojibbeway tribe, does not exceed a total population of 4,000, of whom it is believed about 800 are men capable of bearing arms. Although among these Indians there may be some restless characters, they are considered good Indians on the whole, and if kindly but firmly treated, they are not likely to cause any interruption along this route, or offer opposition to the peaceful settlement of the country.

During the past summer, the Ojibbeway tribe were apprehensive of an attack from the Sioux, their hereditary enemies, dwelling west of the Red River, on the American side of the international boundary line. With a view therefore of preserving the peace of the country, supporting our Indian Commissioner when engaged in making treaties, and for the protection of settlers, I am of opinion that it would be advisable to encamp a detachment of about 100 soldiers during the summer months at Fort Francis. This force could be taken from the Militia now on duty at Fort Garry, returning to that station for the winter months. To send an Indian Commissioner unaccompanied by a military force to make a treaty with this tribe last summer proved a failure. I would further suggest that the *employés* of the Department of Public Works stationed along the line of the "Dawson Route," who will this summer number about 400 men, should be organized into a naval brigade, to be armed and equipped by the Militia Department, and that the offer to raise two volunteer companies of Militia at Prince Arthur's Landing, Thunder Bay, be accepted. The existence of such a material power along the line would, I feel sure, prove of the greatest importance. There is no doubt that the passage of troops for the last three years proceeding to and from Fort Garry in support of the civil power, on missions of peace, has already been attended with the best results.

From the north-west angle of the Lake of the Woods I drove to Fort Garry, in Manitoba, in a waggon with two horses, a distance of 95 miles in a day and a half, the journey from Prince Arthur's Landing thus occupying nine and a half days. The road from the Lake of the Woods to Oak Point, where the prairie commences, is now as good a one as can be found in almost any country part of the provinces of Ontario and Quebec; and from the north-west angle of the Lake of the Woods the ordinary carts and waggons of the country, and almost any kind of light carriage or vehicle, can be driven without difficulty during the summer season, for 1,300 or 1,400 miles across the great prairies of the north-west, through one of the most fertile and beautiful countries in the world, to the Rocky Mountains.

Chapter II.

Inspections in Manitoba.

Arriving at Upper Fort Garry on the 31st July, I inspected the military force on duty there the following day, and the detachments

stationed at the Lower Fort and in the Hudson's Bay Company's post near Pembina, subsequently.

The military force authorised at present to be maintained on duty in Manitoba consists of three hundred infantry formed into a provisional four company battalion under the command of a Major, and an artillery detachment of one Officer and 25 gunners; but at the time of my inspection, the force was considerably below its strength, and divided as follows:—

At Upper Fort Garry............	181	(all ranks)
At Lower ,, ...	20	,,
At the Hudson's Bay Company's post near Pembina	42	,,
Total............	243	,,

The decrease in the strength authorised which then existed, resulted from the discharge of time-expired men, but a considerable detachment was despatched to Fort Garry from the provinces of Ontario and Quebec in October last, to complete the authorised strength.

I am happy to report that on inspecting the infantry battalion, I found it to be in as satisfactory a condition with regard to drill and discipline, as could reasonably be expected, considering the very short periods allowed for the enlistment of the men, and the Officers' uncertain tenure of office. The companies stationed at Upper Fort Garry were encamped at the time of inspection on the banks of the Assiniboine, about one mile from its junction with the Red River; the cleanliness, neatness, and good order of this camp, which was occupied during the whole summer, reflected much credit on Major and Brevet-Lieutenant-Colonel Irvine, the Officer commanding the battalion. On inspecting the detachment at Pembina I found that there was insufficient accommodation in the small trading post of the Hudson's Bay Company at that place for the number of men there stationed. In view of this fact therefore, and the desirability at the time of strengthening the force at Upper Fort Garry, with the entire concurrence of the Lieut.-Governor of the province, I directed the strength of the detachment at Pembina to be reduced to 1 sergeant, 1 corporal, and 12 men; and there being no necessity for keeping any detachment at Lower Fort Garry, with the concurrence of the Lieut.-Governor, I directed the return of the party there stationed, to the Upper Fort. The battalion is now concentrated in the Upper Fort, and as the majority of the men have been recently enlisted to serve for a period of three years, it may be expected that before long the corps will attain to a higher degree of military discipline and training. The respectability of character and good conduct as men exhibited by the majority of the individuals composing the corps during the last twelve months, has been conspicuous. The soldier-like bearing and discipline displayed by the battalion on a recent occasion when called out in aid of the civil power to quell a riot at the time of the elections, proved it to be a corps upon which the Government and the country can rely. The artillery detachment was sent to Fort Garry subsequent to my inspection. With

regard to the barrack accommodation provided for the battalion in the Hudson's Bay Company's trading post, known as the Upper Fort Garry, I found it to be very inadequate, unsuitable, and generally unfit for permanent military occupation. The store buildings used as barracks for the men required a considerable amount of repair to make them fit for occupation in winter. They consist of wooden sheds, some of them mere shells. The building used as the Officers' quarters, which originally was an excellent one, is now very old and decayed. A very considerable amount of repair is required in it—the roof should be entirely new shingled, though it is a matter of doubt whether the building will stand such repairs. The storage room required for military stores is very inadequate and unfit for keeping such stores with safety; and they are in eight different buildings, one good storehouse being all that is required. The armoury in which the spare rifles and arms are kept, is very damp. A powder magazine is required; the Hudson's Bay Company's magazine is generally well filled with their own powder, and is, moreover, very damp. While making this report on the state of the barrack accommodation at Fort Garry, it is but due to the Hon. the Hudson's Bay Company, to state that every assistance and facility in providing for the want of the troops has been afforded by the gentlemen belonging to that great trading Company, as far as circumstances and their own requirements would admit. In very many instances they have placed themselves and their *employés* at no inconsiderable personal inconvenience, in order to accommodate the troops, meet the wishes of Government, and the emergencies of the case.

For the last three years, it has been found necessary to maintain a military force in Fort Garry where only temporary accommodation, as a sort of makeshift, can be provided. The men suffer much during the severe weather in winter from want of proper shelter and accommodation, it is difficult moreover to maintain good order and discipline among a body of soldiers when mixed up with civil *employés* in a Hudson's Bay trading post, and the arrangement altogether, except as a temporary measure, is very inconvenient and unsatisfactory. Under these circumstances, provided it be in harmony with the policy of Government, I would respectfully urge that no further time be lost in taking the necessary steps to supply the military force required, with proper barrack accommodation. On enquiring of the men if they had any complaints to submit relative to their pay, rations, &c., and general treatment, in accordance with my duty, they expressed themselves as perfectly satisfied with their rates of pay, scale of rations, and treatment by their Officers, but invariably in the most respectful manner complained of the wretched barrack accommodation. I feel bound to say that their complaints on this head were just, and to state that it would be only fair to meet the reasonable wants of the men on this point. At no great expense, and with very little trouble, suitable log huts can be erected on advantageous ground, and the greater portion of the work carried out by the men themselves. This arrangement would, I believe, eventually be found the most economical one for the country, if it be the intention to keep a military force in Manitoba,

and it certainly is a very essential one for maintaining the efficiency and welfare of troops. Already the amount of money spent on repairing old buildings and constructing new ones in the Hudson's Bay Company's post would have sufficed to defray the cost of providing proper barrack accommodation in log huts for the force stationed at Fort Garry. I would further urge, if it be the intention of Government to retain any military force on duty in Manitoba, that one hundred men of the provisional battalion be supplied with horses and equipped as mounted riflemen; that an addition of 1 officer and 25 gunners from the School of Gunnery at Kingston be made to the artillery detachment, and the artillery supplied with four of the Horse Artillery guns recently obtained from England. Thus the force would form a small but effective field brigade, and its military power be greatly increased.

With regard to the necessity for maintaining any military force at Fort Garry, no doubt whatever exists in my mind as to the propriety of doing so, in view of the presence of many bands of Indians, considering the primitive state of society in the province, the strong political party-feeling which exists, and the fact that on both sides of the international boundary line, restless and reckless characters among both white men and Indians abound. It is undoubtedly very desirable to maintain a certain number of police constables in the province under the civil power, some of whom should be mounted, but I feel satisfied that the great security for the preservation of good order and the peace of the north-west territories, under the changing state of affairs, will for some years be found to lie in the existence and presence of a disciplined military body, under its own military rules, in addition to, but distinct from, any civil force which it may be thought proper to establish. Whatever feeling may be entertained towards policemen, animosity is rarely, if ever, felt towards disciplined soldiers wearing Her Majesty's uniform, in any portion of the British Empire. In the event of serious disturbance, a police force acting alone, and unsupported by a disciplined military body, would probably be overpowered in a province of mixed races, where every man is armed, while to maintain a military without any civil force is not desirable. I believe that a small number of constables will be sufficient to maintain order in the province, provided the military force is maintained; but that, in the event of serious disturbance, a large police force would be unable to do so, should the military be withdrawn, and I consider the presence of a military force in the north-west territories for some years to come as indispensable in the interests of peace and settlement.

During my inspection in the north-west, I ascertained that some prejudice existed amongst the Indians against the colour of the uniform worn by the men of the provisional battalion. Many of them had said, "Who are those soldiers at Red River wearing dark clothes? Our "old brothers who formerly lived there"—meaning Her Majesty's 6th regiment—"wore red coats," adding, "we know that the soldiers of "our great mother wear red coats, and are our friends." With the view, therefore, of reassuring the Indian mind, and for other reasons, I recommended a change of uniform; this has been carried out; the

Militia on duty at Manitoba now wear red coats, and the matter, apparently small in itself, will probably prove of great value and importance hereafter.

On the 8th of August I inspected the Winnipeg Field Battery, a militia artillery corps, recently organized, and composed of citizens resident in the town of Winnipeg. This battery is under the command of Major Kennedy, a very zealous Officer, but it has not as yet been armed. On the occasion of inspection, the corps took part in a field day, brigaded with the provisional battalion. The battery was armed for the day with some light field guns belonging to the Hudson's Bay Company, kindly placed at their disposal by the Hon. Donald Smith, M.P., chief factor. As soon as circumstances will admit, it is recommended that this battery should be armed with four of the horse artillery field guns recently obtained from England, and supplied with the necessary harness and artillery stores.

The Militia in the province of Manitoba is under the command of Lieutenant-Colonel Osborne Smith, C.M.G., Deputy Adjutant-General, who reports that in the month of May, 126 men of the provisional battalion will probably obtain their discharge on completion of service. That number of men should, therefore, be sent to Fort Garry by the Dawson route so soon as the navigation opens, to maintain the force at its authorised strength; and one Officer and twenty-five gunners should be despatched in addition, to render the artillery detachment more effective.

Chapter III.

From Fort Garry to the Rocky Mountain House.

Having concluded the inspection of the Militia in Manitoba, accompanied by my son, a youth sixteen years of age, as travelling companion, I left Fort Garry on the 10th of August for the Rocky Mountains and British Columbia, with one guide only, and an Indian lad of the Salteux tribe, to cross the continent through Dominion territory to the Pacific coast. The Hudson's Bay Company provided ten horses, two Red River carts, and a suitable equipment for the party, and undertook to supply any guides, horses, and provisions required *en route*, from the different posts in the Swan River and Saskatchewan districts as far as Fort Edmonton or the Rocky Mountain House; but beyond these posts they could not guarantee further progress, nor a safe passage through the country of the Blackfeet Indians, should circumstances require the adoption of that route. Every possible assistance, however, was afforded me by the Hon. Donald Smith, M.P., and the gentlemen connected with the Company at the various posts visited, and my best thanks are due to them, not only for many acts of kindness and hospitality, but for much valuable information respecting the Indian tribes.

At the time of departure from Fort Garry, some doubt was expressed as to the propriety of so small a party travelling without a guard through the Indian territory, and especially through the country of the

Blackfeet tribe, if found necessary to do so; and I have to thank the Government very much for the authority conveyed by your telegram to Fort Garry, to take with me, if desired, a personal escort of six soldiers from the battalion on duty in Manitoba. On full consideration, however, and with the advice of those best able to judge, I did not think it advisable to do so. A military escort of only six men would be inadequate to afford protection in case of any real danger from the Prairie Indians, and might possibly invite attack. Considerable additional expense, moreover, would have been entailed for their transport and subsistence.

Proceeding from Fort Garry through the Swan River and Saskatchewan districts, *viâ* the Hudson's Bay Company's posts of Forts Ellice, Carlton, Pitt, Victoria, and Edmonton, I arrived at the Rocky Mountain House—about 1,200 miles distant from Fort Garry—in 31 days, of which 25 days only were occupied in actual travel. The prairie road or cart trail, extending the whole way from Fort Garry to the Rocky Mountain House, and which has been used for many years by the Hudson's Bay Company, was at that season of the year in excellent order. Many of the streams have been roughly bridged by the Hudson's Bay Company's servants; and except at the crossing of the South Saskatchewan River, where we lost a whole day from the necessity of swimming our horses across, and repairing a damaged scow on which to convey over the carts and baggage, we met with very little difficulty or trouble at any time. For great distances the road led over prairie ground almost as level as a race course. It would be desirable to bridge the Little Saskatchewan River, Birdtail Creek, and Snake Creek, between Fort Garry and Fort Ellice, and to improve the descent to and ascent from the Assiniboine River at Fort Ellice, as owing to the steepness of the road it is somewhat difficult to pass at this point during rainy weather with loaded carts. In addition to this, some repairs and improvements are desirable on the road between Forts Pitt, Victoria, and Edmonton, and across one or two swamps near the Rocky Mountain House; but on the whole a very trifling amount of labour is all that is at present required.

On the journey from Fort Carlton to Edmonton, a distance of between 300 and 400 miles, we were accompanied by the wife of our guide (an *employé* of the Hudson's Bay Company), who with her three young children travelled in a light four-wheeled canvas-covered waggon, driving the vehicle herself nearly the whole way.

It was my intention to overtake at Edmonton, if possible, Mr. Fleming, Chief Engineer of the Pacific Railway, who had started from Fort Garry ten days before me for British Columbia, and in company with him cross the Rocky Mountains by the "Tête Jaune Pass;" on arrival at Edmonton, however, I found that he had quitted that point seven days previously. As no guides could be obtained at Edmonton either for the Tête Jaune or any other pass, it was necessary to proceed to the Rocky Mountain House, a trading post for the Blackfeet Indians, distant about 180 miles south-west from Edmonton, in sight of, and about forty-five miles distant from, the first range of the Rocky Mountains.

Between Fort Garry and Fort Ellice, a distance of 230 miles, the country is diversified and undulating, generally speaking very good and fertile. In some parts alkali lakes are occasionally met with. The open expanses of prairie are relieved with numerous clumps or patches of wood, termed "bluffs." There is plenty of wood suitable for fuel, or for sheltering stock. The wood consists of spruce, willows, birch, and poplar, and in the valley of the Assiniboine there is a good deal of oak. The land in the lower part of the valley of the Assiniboine, for nearly one hundred miles before its junction with the Red River, is of great richness and fertility. Between the western boundary of the province of Manitoba and Fort Ellice, the country in the vicinity of Pine Creek, the Little Saskatchewan River, Shoal Lake, Birdtail Creek, and Snake Creek, is well suited for settlement and farming purposes, more particularly for the raising of stock; but I do not think the soil, generally speaking, so well suited for wheat crops as along the lower parts of the valley of the Assiniboine and Red River. Fort Ellice is situated a short distance from the junction of the Qu'appelle with the Assiniboine River, on the right bank of the latter stream. It is well placed in a military point of view, being built on a plateau at the top of a high, steep, and thickly wooded bank, about two hundred feet above the river. The river is here about sixty yards in breadth and about fifteen feet in depth. The banks are thickly wooded. The Hudson's Bay Company have erected a bridge across the river. The valley of the Assiniboine is depressed about 250 feet below the Prairie level, and is about three-quarters of a mile in breadth. The country around the immediate vicinity of Fort Ellice is well wooded and suitable for settlement. The wood consists chiefly of poplar of no great size, and there is some oak. The Fort itself merely consists of some wooden houses, built of poplar, and surrounded by a stockade, but it might easily be made very defensible, and accommodation for fifty soldiers in addition to the present occupants, readily created.

The Assiniboine River is navigable for good-sized boats all the way from Fort Garry to Fort Ellice, and I believe much further. In spring, no great difficulty would probably be experienced in navigating the river with a stern-wheel steamer of light draught the whole way from Fort Garry to Fort Ellice. Between Fort Ellice and Fort Carlton, on the North Saskatchewan, lies a great extent of country—more than three hundred miles. Throughout a considerable portion of the road followed, alkali lakes are prevalent, and for several days I found no good water.

Upon the whole I do not consider the country between Fort Ellice and the Touchwood Hills, which are about midway between Fort Ellice and Carlton, and the country beyond the Touchwood Hills for two or three days' journey towards the north-west, so well adapted for settlement as the province of Manitoba, and the country between it and Fort Ellice. From that part of the country, however, where the "Round Hill" (a conspicuous object about two days' journey south of Fort Carlton) is situated, to North Saskatchewan River, and from thence for several hundreds of miles westward to the Rocky Mountains,

the value and fertility of the country for agricultural and stock-raising purposes has certainly not been exaggerated in the accounts of any travellers.

The North Saskatchewan at Fort Carlton is about four hundred yards in breadth, with a current of between two and three miles; and it nowhere exceeds that breadth upwards to the Rocky Mountains. Although there are numerous sand bars, it is navigable for large-sized boats, and I believe for stern-wheel steamers of light draught from within about twelve miles of Lake Winnipeg nearly to the base of the Rocky Mountains. When the river is low, steamboats probably would not be able to pass at Coal Rapids below Carlton. At the proper season of the year for navigation, however, it is only necessary to make one or two portages the whole way from Fort Garry, on the Red River, to the Rocky Mountain House. The land lying between the north and south branches of the Saskatchewan River, near Carlton, and for many miles to the east and west, is particularly well adapted for settlement, and the whole country along the north bank of the North Saskatchewan, extending for hundreds of miles to the westward, is very fertile and admirably adapted for settlement. There are two half-breed settlements at no great distance from Fort Carlton—one at St. Laure (French half-breed), on the South Saskatchewan, about 30 miles south-west from Fort Carlton; the other, an English half-breed settlement (Prince Albert), 50 miles east from Fort Carlton, on the North Saskatchewan. The population of St. Laure, last year, was 68 men, 58 women, and 198 children, possessing 577 horses; that of Prince Albert, 35 men, 57 women, 81 children, and 181 Indians. The population of these two settlements is probably much increased since this census was made, and it is believed that a considerable number of the half-breed population in Manitoba will leave that province next summer and move to these settlements.

The country to the south of the North Saskatchewan, leading towards what are called the Great Plains, I understand is by no means so fertile or so well suited for agriculture; and there is there, I believe, a scarcity of both fuel and water. Some doubts may exist as to the possibility of raising as large wheat crops along the valley of the North Saskatchewan, from the occasional occurrence of summer frosts, as can be raised in the province of Manitoba; but I believe that for stock farming, vegetables and the hardier grains, such as oats, barley, &c., the fertile belt of British North America can hardly be surpassed.

With regard to the temperature of the climate, on very few occasions was there any interruption to its mildness in the past summer during the months of June, July, August, September, and October. On the night of the 17th August, when travelling between Fort Ellice and the Touchwood Hills, I experienced a slight frost, but not sufficient, so far as I could judge, to materially injure wheat crops. Again, on the night of the 10th September, when about two days' journey from the Rocky Mountain House, I experienced another similar frost—these were the only occasions during the past season that I experienced any frosts or cold, until reaching the foot of the Rocky Mountains on the 21st September near the Porcupine Hills, being then at an altitude of

between 3,000 and 4,000 feet above the sea level—and at the time of the Equinox, I was stopped for several days by a snow storm, which not unfrequently occurs in the mountains, but rarely so early on the plains. This snow disappeared from the plains in a few days, almost as rapidly as it came, and with the above exceptions, from the time of quitting the Lake of the Woods, one hundred miles east of Fort Garry, until reaching the Pacific Coast, a period of three months, the climate was delightful—it was frequently quite unnecessary to pitch a tent when camping for the night; for many nights I slept out in the open air, or lay underneath the cart.

It takes twenty days to go with large-sized row boats, carrying cargo, from Carlton to Fort Edmonton, but a light draught steamer would accomplish the distance in a short time. Gold is to be found in the sand bars of the Saskatchewan the whole way from Fort Edmonton to Carlton, and almost throughout its entire length. I was informed that at Carlton a man can earn from two to three dollars daily, during the proper season, by washing the sand of the river,—and at Fort Edmonton, from five to six dollars daily for seven or eight months in the year.

At Fort Edmonton during the past summer there were only five or six men engaged mining, from one of whom I obtained some good specimens of the Saskatchewan gold, which is considered equal in quality to that obtained in the mines of British Columbia. The few miners who have as yet penetrated into the Saskatchewan country state that gold is to be found in nearly all the streams which flow into the Saskatchewan River, and they are of opinion that quite as rich deposits exist on the eastern as on the western side of the Rocky Mountains.

The Hudson's Bay Company's forts along the line of the North Saskatchewan at Carlton, Pitt, Victoria, and Edmonton consist of wooden houses surrounded by stockades; these stockades are about twenty feet high with small bastions at the angles to afford flanking defence—although probably sufficient to afford protection from Indians, they are of slight strength. At Forts Carlton, Pitt, and Victoria, accommodation for companies of soldiers, 50 strong, could be found in these Hudson's Bay Company's forts, in addition to the present occupants, and at Fort Edmonton, for about 125 soldiers. These forts are conveniently enough situated for purposes of trade, but in a military point of view are badly placed, being in nearly every instance commanded from the rear by higher ground. The Rocky Mountain House, however, is built on a good military site, and could easily be put in a defensible condition.

The scenery about the Touchwood Hills, as well as in many other sections of the country lying between Forts Garry and Edmonton, is extremely picturesque and park-like. At the time of the year I passed through, the wild flowers were in full bloom; the prairie covered with beautiful plants and countless roses, both red and white, presented a gorgeous appearance; not unfrequently when camping for the night the traveller literally makes his bed upon roses.

Fort Carlton and its vicinity is a desirable spot for settlement, but the whole country along the north bank of the Saskatchewan to Edmonton

is at least equally so, offering in many places superior advantages from the greater quantity and better quality of the timber.

From Edmonton to the Rocky Mountain House, especially in the neighbourhood of the Battle River and Wolf Plain, the country is still richer and better wooded.

At Fort Victoria, where a small settlement has arisen, and at Fort Edmonton, I saw several fields of excellent wheat being harvested. I have no doubt whatever that when the valley of the North Saskatchewan is opened up and settled, it will be found to be very productive.

That beautiful country lying in the territory of the Blackfeet Indians, extending for about 300 miles along the Eastern base of the Rocky Mountains towards the International boundary line, with a varying breadth of from 60 to 80 miles, is in respect of fertility, of surpassing richness—in regard to scenery, magnificent. The effect produced upon the mind of the traveller who journeys day after day through these vast and beautiful solitudes is of an elevating character; the recollection of the scenes visited, remains deeply impressed upon the memory.

The average temperature during the winter months along the base of the Rocky Mountains in this section of the country, is higher by 15° than that of the western portion of the province of Ontario; all over the Saskatchewan country, horses and cattle winter out. All travellers and old residents in the West, testify to the healthiness of the climate—indeed, in the pure air of the prairie, sickness is almost unknown.

Scattered through the whole of the Saskatchewan country, are numerous lakes generally of no great size; they are the favourite haunts of great numbers of wild duck and geese. Some of the lakes between Forts Carlton and Edmonton, such as Egg Lake, Jack Fish, and Saddle Lake are, however, of considerable size, and contain immense quantities of white fish.

Wild pigeons and prairie hens abound everywhere. In the Touchwood Hills and along the eastern base of the Rocky Mountains, several kinds of deer and bears are very numerous. When travelling through the Touchwood Hills, I killed a bear of the grizzly species, but one of no great size. On the 23rd of September, near the Porcupine Hill, at the base of the Rocky Mountains, I killed another grizzly bear of very large size, the animal weighing about 1,100 lbs. In the country adjacent to the Bow River, and thence southward towards the boundary line, numerous herds of antelope were seen, and some of them were killed by our party. During the past summer, the buffalo were very numerous on the great plains that lie between the North and South Saskatchewan Rivers.

Chapter IV.

From the Rocky Mountain House across the Mountains, viâ "Wild Horse Creek," to Victoria, Vancouver Island.

On arrival at the "Rocky Mountain House," I learned that to cross the mountains into British Columbia by the "Vermilion Pass" with horses was impossible, owing to the immense quantity of fallen timber

caused by a great storm in the mountains last spring. An attempt to cross by this pass had been made by a party of Assiniboine Indians early in the summer, without success. Under these circumstances, it became necessary to undertake a journey of about 300 miles through the country of the Blackfeet Indians, and to cross the mountains by the North Kootanie Pass.

Through the kindness of Mr. R. Hardesty, the gentleman in charge of the Hudson's Bay Company Posts in the Saskatchewan district, I obtained the services of three guides from the Post of the Rocky Mountain House, one of whom was "William Munro," the Hudson's Bay Company's interpreter for the Blackfeet Indians, better known throughout the Saskatchewan country by his Indian name of "Piskaan." This guide is a brave man, and one of the most famous travellers and hunters in the service of the Hudson's Bay Company. In company with him and the two other guides, one of whom was a Rocky Mountain Assiniboine Indian, the other a French half-breed, I started along with my son from the Rocky Mountain House, on the 16th September, to pass through the country of the Blackfeet Indians, and cross the mountains by the Kootanie Pass into British Columbia.

The Blackfeet tribe of Indians have always been much dreaded, and their country carefully avoided by travellers. From information obtained at the Rocky Mountain House, and while travelling, it appears that this tribe, which is the most numerous and warlike one of the Prairie Indians in Dominion Territory, is divided into five distinct bands, or rather clans, each band under its own chief, but all maintaining a close connection. These bands are called and known as follows:—

1st. The Sik-si-ka or Blackfeet proper; this band numbers about 700 men, 1,000 women, 1,100 children, possessing about 3,000 horses and ponies, 400 dogs, and having the following arms:—105 rifles, 260 revolvers, 436 flint guns, 286 bows, 48 spears, 37 war axes.

2nd. The Piegans (subdivided into Northern and Southern Piegans) numbering nearly 800 men, 1,100 women, 1,400 children, possessing about 3,500 horses and ponies, 600 dogs, and the following arms:—213 rifles, 412 revolvers, 320 flint guns, 181 bows, 54 spears, 41 war axes.

3rd. The Ka-na-ans (or Blood Indians), numbering about 600 men, 800 women, 900 children, possessing about 2,500 horses and ponies, 480 dogs, and having the following arms:—141 rifles, 318 revolvers, 202 flint guns, 216 bows, 45 spears, 32 war axes.

4th. The Sar-cis (or Beaver Indians), numbering about 100 men, 130 women, 150 children, possessing about 150 horses, 300 dogs, and having the following arms:—6 rifles, 14 revolvers, 64 flint guns, 26 bows, 4 spears, 7 war axes.

Although the Blackfeet may number altogether about 2,350 men, many of these are old, and some of them mere boys. It is not believed that they could bring into the field more than 1,000, or 1,100 men, if as many. They keep together by bands for mutual protection, in what is termed in military language, standing camps; as many as 100 or 150 tents being pitched together, and their chiefs have con rol over the

young men. Their war parties usually consist of only 50 or 60 men, and when on raiding expeditions against hostile tribes, they can make, with horses, extraordinary marches. With the Blackfeet, as with all the Indians in the Western Prairies, when at war, murder and assassination is considered honourable warfare. There are many fine-looking men among the Blackfeet, Sioux, Plain Crees, and other tribes, and they have a bold and military bearing. Their active wiry figures, and keen glittering eyes, betoken high health and condition, and they can endure great hardships and fatigue; but on the whole, the Indians are not equal, in point of physical strength or appearance, to white men hardened by active exercise and inured to labour. As a rule, the Prairie Indians are bold and skilful horsemen, but they are not very skilful with firearms. The Blackfeet and Plain Crees follow the buffalo, subsisting entirely by the chase; they therefore require a great many horses and dogs for transport and hunting purposes. In the present year, peace having existed for the past two summers between the Crees and Blackfeet, and accompanied as I was by a guide well known, and related to the latter tribe, I did not think there was much danger in travelling through their country. There is always, however, great danger, if mistaken for an American citizen, and on approaching the International line, near the Porcupine Hills, of meeting with hostile bands of the Gros Ventres and Crow Indians, from the territories of Dacotah and Montana, United States, who frequently cross into Dominion Territory on horse-stealing expeditions, and who are not likely, if they fall in with travellers, to make distinctions.

From the Rocky Mountain House, the party being increased to five, we took with us twelve horses, one Red River cart for baggage, and carried twelve days' provisions, intending to take the cart as far as practicable, and then câche it. After leaving the Mountain House, no path or trail could be seen, and we journeyed through the country and over the prairies, led only by the instinct of the guide. After travelling for two days through thick wood country, in a south-easterly direction, and crossing the Red Deer and Little Red Deer Rivers, we emerged on the Great Plains, following a route seldom taken by the white man.

On the 18th September, we reached the South Saskatchewan, here called the Bow River, but owing to the difficulty of finding a practicable ford, did not succeed until the following day in effecting a passage with our horses and baggage. Whilst carrying out this operation, the Assiniboine Indian deserted, but subsequently rejoined the party, fearing, probably, to be left alone in the country of the Blackfeet, the hereditary enemies of his tribe. We found the water here of the South Saskatchewan, icy cold, flowing as it does out of immense glaciers in the Rocky Mountains.

On the 21st September we reached the north-west bank of the Porcupine Hills, and when almost at the foot of the Livingstone Range of the Rocky Mountains, about eighty miles to the north of the International Boundary line, our progress was stopped by a violent snow-storm, and we were forced to camp on the open prairie. For two days and two nights it snowed without intermission, the mountains were soon

covered, and by the evening of the 22nd the snow lay two feet deep all over the plain. The situation became somewhat difficult—stopped at a point 250 miles from the Rocky Mountain House, and as far from any other source of supply, with only five or six days' provisions left, the guide declaring that to cross the mountains had now become impossible. Fortunately the storm occurred before entering the mountains, or the probability is, that the animals would have been lost, and our party placed in a very critical position.

On the 23rd the weather cleared, and on the afternoon of that day we killed a large grizzly bear which had approached to within a few yards of our camp, the animal having lain all the previous night close to it. This event afforded us a timely supply of meat, relieving our anxiety on that point, although in a case of extremity, the horses would have supplied food, it was necessary to save them if possible for transport. We remained snowed up for six days, then, abandoning the cart and all superfluous baggage started on the 27th with the horses for the Kootanie Pass, resolving to push through the mountains if practicable, and if unable to do so to make for Fort Benton, on the Missouri, a United States military post in Montana, distant about 250 miles to the south-east.

Owing to the depth of snow we did not make more than four miles on the 27th.

On the 28th we made about sixteen miles, the snow disappearing rapidly, the weather now very fine, and on the following day clearing the snow altogether (our route lying in a southerly direction), we crossed the Belly River, and reached the south end of the Porcupine Hills, opposite the entrance of the Kootanie Pass, about 50 miles to the north of the International Boundary line.

The country around the Porcupine Hills is justly considered the richest and most beautiful part of the Saskatchewan territory. It is a favourite wintering ground for great herds of buffalo, and of the Blackfeet Indians, who at that season of the year pitch their camps on either slope of the Porcupine Range, or in the sheltered and fertile valleys along the eastern base of the Rocky Mountains.

During the nights of the 27th, 28th, and 29th, we kept on the alert, having during the day time observed the fresh trail of a mounted man, keeping always a short distance in advance of our party, but never visible to us. From certain signs well understood by the guides from their knowledge of Indians and Prairie life, they were of opinion that we were being watched at this time by some scout belonging to a hostile party of the "Gros Ventre" or "Crow" Indians from south of the line, with a view to horse stealing; it was necessary therefore to keep the horses close to us at night and well hobbled, and to keep a look out for our own safety.

On the 30th September, when entering the Kootanie Pass, we observed a mounted Indian galloping along the side of a mountain. After some hesitation this Indian approached, and on finding that we were not a party of the dreaded Blackfeet, he exhibited great pleasure. He proved to be a scout belonging to a band of Kootanie Indians who had crossed the mountains from the Western side, to hunt buffalo on

the Eastern Prairies. After proceeding a few miles accompanied by this man, and passing several mounted Indians, posted as scouts on the look-out, we met the main body of the band on the march, and at the request of the chief, camped and remained a day with them, being treated in the most friendly manner. There were about sixty or seventy men in the band, exclusive of those scouting; they had with them more than 200 horses, among which were some good animals; most of the men were armed with guns, some carrying revolvers in addition; a few, however, were only equipped with bows and arrows, war axes and knives. Although not actually at war with the Blackfeet, they were apprehensive of attack, and the manner in which these poor Indians performed outpost duty, would have taught a lesson to the soldiers of more civilized countries. One of the leading men insisted upon presenting us with a horse, and when I expressed a desire to obtain one or two of their men as guides, and to assist in crossing the mountains, the chief directed three to accompany us as far as we wished.

The Kootanie Indians from the western side of the mountains are much more civilized than the Crees or Blackfeet (these latter as regards habits of life being little better than mere animals). During the day I was with the Kootanie band, a bell was rung three times in the camp for prayers. They are noted hunters, good horsemen, and were quite prepared for a brush with the Blackfeet if called on.

Continuing our journey we crossed the Rocky Mountains in two days, riding and scrambling over rough ground. Owing to the quantity of fallen timber, some of which was of great size, we experienced considerable difficulty in getting the horses through, but except on the summit of the Pass, there was no snow on the trail.

The weather was then, on the 1st of October, very fine and quite mild. On the 4th of October, by which time the provisions were exhausted, we reached the Gold Miners' camp of Wild Horse Creek, in the Kootanie District of British Columbia, where we were most hospitably received by the Gold Commissioner and Stipendiary Magistrate of the district, Mr. Arthur Vowell, and our wants supplied.

In crossing the Rocky Mountains by the Kootanie Pass, there are two distinct ranges. The height of the summit of the first pass is about 6,300 feet above the sea—the mountains on either side, however, being double that altitude and capped with perpetual snow. The height of the second pass is nearly the same; the track is well defined, and has been used for many years by the Kootanie Indians. In some places the path is very narrow, leading over high and dangerous ground—we found it necessary frequently to dismount. The distance from the eastern to the western entrance of the pass in the Kootanie Valley is about 47 miles. It would be difficult to describe, in adequate language, the beauty and grandeur of the scenery all through. It is impossible to take any wheeled vehicle at present through the Kootanie, and when there is snow in the mountains in any quantity, horses cannot pass. The present horse trail, however, might be easily improved—a party of fifty men could, in the course of a single season, make it equal to the ordinary horse trails in the Province of British Columbia. Considerable labour however would be required to make a

waggon road, and to carry a railway across the mountains by this pass, it would be necessary to tunnel through two mountains.

The Stipendiary Magistrate of the Kootanie district, British Columbia, resides at Wild Horse Creek; there is a population of from twenty-five to thirty white men, gold miners there, and about one hundred Chinese. The miners, at that time, were not making more, on an average, than five or six dollars per man per day. Ample supplies of beef and flour, at moderate price, can be obtained; but the price of clothing and other supplies is very high, such supplies having to be brought on mules or pack horses, either from Walla Walla, in Washington Territory, United States, or from the town of Hope, on the Fraser river, British Columbia, a distance of four hundred and fifty miles.

A custom-house has been established at Joseph's Prairie, about 14 miles from Wild Horse Creek, with excellent effect; and if a similar one was established on the eastern side of the mountain with a military guard at the Porcupine Hills, a still better result would be obtained.

The postal communication from the Kootanie District to Victoria, is as yet very bad, and it is very desirable to improve the present trail leading *viâ* Osoyoos and the Simil-Kameen to the town of Hope, on the Fraser, or to make a waggon road.

The district of Kootanie is of great extent, embracing an area of 32,000 square miles. The total population amounts to about eighty-five white men, two hundred Chinese, and 400 or 500 Kootanie Indians. There is an immense quantity of fine timber in the Kootanie District, and in the valleys of the Rocky Mountains, chiefly cedar and pine trees of great height and size; and the mineral resources are believed to be very great. The valleys between the different hill ranges in the Kootanie District are, generally speaking, fertile and well adapted for farming. There are four gold mines in the district, namely, Wild Horse Creek, Perry's Creek, Palmer's Bar, and Weaver's Bar—only the two former, however, are being worked.

The government of the district was at the time of my visit under the able administration of Mr. A. Vowell, Stipendiary Magistrate and Gold Commissioner.

"Wild Horse Creek," although situated in a lovely country, is itself one of the most desolate spots imaginable; a narrow rugged valley, surrounded by lofty hills, in the heart of the Rocky Mountains. From Wild Horse Creek, the guides who had accompanied me from the Rocky Mountain House, after obtaining fresh supplies, started on the 8th of October to return to the Rocky Mountain House, intending to take what they hoped might prove a shorter route, and one safer from risk of Indian molestation.

After my return to Ottawa, I learnt that they effected the return journey to the Rocky Mountain House with safety in eighteen days, recrossing the mountains by the Ispasquehow Pass; ten days were occupied in crossing the mountains, and much difficulty encountered—two of the horses rolled down an immense ravine, but were fortunately not much hurt. The Assiniboine Indian deserted the two other guides in crossing the mountains, thereby greatly increasing their

labour. Arriving at the spot where the cart had been "cached," the two guides recovered it, and returning from thence by the route originally taken, reached their home at the Rocky Mountain House towards the end of October without accident or the loss of a horse. These two guides alone completed a trying and adventurous journey of several hundred miles with no further damage or deficiency, than the loss of two saddles and an axe. They saw immense herds of buffalo on the return journey, and at the Bow river fell in with a party of American smugglers, having waggons with them, containing whisky and ardent spirits, with which to carry on their illicit and nefarious traffic with the Blackfeet tribe—a kind of traffic which enables these unscrupulous traders to realize large profits, rob the Indians of buffalo robes, and valuable furs, and causes annually certain bloodshed amongst the Indian tribes.

On the 8th October with one guide only and five horses obtained at Wild Horse Creek, I continued the journey from there, and after fifteen days' travel, proceeding *viâ* the Mooyie River, Lake Pen d'Oreille, the Spokane and Snake Rivers, arrived at the settlements of Walla Walla and Walula, in Washington Territory, United States.

It had been my intention to proceed from "Wild Horse Creek" to the town of Hope, on the "Fraser," a distance of about 500 miles, *viâ* Fort Shepherd, Lake Osoyoos, the Okanagan country, and Similkameen River, but owing to the lateness of the season the guide was unwilling to take this route.

The journey from Wild Horse Creek to Lake Pen d'Oreille was tedious and fatiguing, having only one guide to share with me and my son the labour of travelling with horses for many days along an Indian track encumbered with fallen timber, and through a rugged, densely wooded, and difficult country. The scenery from Wild Horse Creek to Lake Pen d'Oreille, and especially about that lake, is very beautiful; but further south, on reaching the Spokane River, United States, the country presents the appearance of an arid waste; Washington Territory, United States, being partly situated in what is known as the great Columbian Desert. Washington Territory, United States, is, however, as well as many parts of British Columbia, admirably suited for horses and cattle, from what is known as "bunch grass," growing there in great perfection.

From Walula, descending the Columbia, I proceeded, *viâ* Portland, in Oregon, Olympia, and Puget Sound, to Victoria, in Vancouver's Island, arriving at Victoria on the 28th day of October, having accomplished the journey from Fort Garry in 70 days, of which only 51 were occupied in actual travel,—the distance by the route followed from Fort Garry to Vancouver's Island being nearly 3,000 miles,—of this distance considerably more than 2,000 miles were travelled on horseback. After remaining 14 days at Victoria, visiting the Island of San Juan, in company with the senior naval Officer of H.M.'s ships, and arranging for the organization of the Militia in the Province of British Columbia, I returned to Ottawa, *viâ* San Francisco and the United States Pacific Railway, stopping for two days to visit the Mormon City, at the Great Salt Lake in Utah Territory.

Chapter V.

General Remarks.

During the journey from Manitoba to the Pacific Coast, an opportunity was afforded me of becoming acquainted with the state of affairs in the Saskatchewan and the condition of the Indian tribes. Every possible information was furnished by the missionaries whose acquaintance I made, and by the *employés* of the Hudson's Bay Company; in the course of the journey I met with many bands of Indians.

Between Fort Garry and Portage de la Prairie, three large camps of the Sioux tribe were visited; a portion of the same band who in 1862 massacred some American settlers in Minnesota, United States, in retaliation for the many wrongs and outrages committed in the first instance on them by American citizens. Ever since that event, this band has sought refuge in Dominion territory. These Sioux Indians live quietly enough apparently among our people, and occasionally assist the farmers at harvest time. The presence, however, of such a wild and warlike-looking band in the settlement frequently causes no small apprehensions amongst the settlers dwelling near Portage de la Prairie; and it should be remembered that at the time of the Minnesota massacre this very band, although living quietly apparently among the Minnesota settlers, rose suddenly in one night and swept the settlement, committing horrible atrocities. Before reaching Fort Ellice I met two bands of the same tribe, one consisting of about 100 men, unaccompanied by women or children, who told me they had been to visit the Lieutenant-Governor of Manitoba in hopes of obtaining presents. This band belonged to the United States, and had come all the way from the plains south of the Missouri River, whither they were returning. These Indians were bold and wild-looking fellows, fantastically dressed, and all armed. They were perfectly friendly in their manner.

On one occasion, when far out on the prairie, a band of 10 mounted Sioux, after reconnoitring from a distance, rode rapidly towards our small party of four (two of whom were only boys), surrounding us in a moment; on being told by the guide, who spoke their language very well, that I was not an American citizen, but a British Officer travelling towards the Rocky Mountains, they became quite friendly in manner, shaking hands with us heartily. Subsequently this band were somewhat bold and pressing in their demands for presents, which we resisted in a firm but friendly manner, it being bad policy to comply with extortionate demands, or to appear in dealing with Indians, to act from intimidation.

Between Fort Ellice and Fort Carlton I met some bands of the Saulteaux tribe; at the various forts along the North Saskatchewan several of the Cree tribe (plain Crees), and at the Rocky Mountain House, some Blackfeet and Assiniboine Indians.

Although there may not at present be much risk in travelling through Saskatchewan territory along the well-known track followed for so many years by the Hudson's Bay Company, especially when associated

with an *employé* of the company speaking the Indian language, it is a matter of doubt if such can long continue under the changing state of affairs, *without the introduction of some Government supported by material force.*

Beyond the Province of Manitoba, westward to the Rocky Mountains, there is no kind of Government whatever at present, and no security for life or property beyond what people can do for themselves. The few white men there are in the Saskatschewan country and at the Hudson's Bay Company Forts, frequently expressed to me their conviction that, unless a military force be established in the country, serious danger is to be apprehended. The clergy of all denominations whom I met with expressed similar convictions; those at Forts Victoria and Edmonton, as representatives of the community, urged me in the most impressive manner to lay their claims for the protection of themselves, their wives, and families, before his Excellency the Governor-General of the dominion and the Government of their country. It appears that of late years no attempt has been made to assert the supremacy of the law, and the most serious crimes have been allowed to pass unpunished. Hardly a year has passed without several murders, and other crimes of the most serious nature, having been committed with impunity.

During the present year, about three weeks before my arrival at Edmonton, a man, by name Charles Coudin, a French-speaking half-breed, cruelly murdered his wife at no great distance from the gate of the Hudson's Bay Company's Post. I was informed that the criminal might have been arrested, but that there was no power to act. This same man had previously most wantonly and cruelly mutilated an old Indian woman by cutting the sinews of her arm so as to incapacitate her for work.

At Edmonton there is a notorious murderer, a Cree Indian, called Ta-ha-kooch, who has committed several murders, and who should have been apprehended long ago. This man is to be seen walking openly about the Post. Many instances can be adduced of a similar kind, and as a natural result, there is a wide-spread feeling of apprehension. The gentleman in charge of the Hudson's Bay Company's Post at Fort Pitt, as well as others elsewhere, assured me that of late the Indians have been overbearing in manner, and at times threatening. Indeed, the white men dwelling in the Saskatchewan are at this moment living by sufferance, as it were, entirely at the mercy of the Indians. They dare not venture to introduce cattle or stock into the country, or to cultivate the ground to any extent, for fear of Indian spoliation.

When at Edmonton and the Rocky Mountain House, I was informed that a party of American smugglers and traders have established a trading post at the junction of the Bow and the Belly Rivers, about 30 miles due east from the Porcupine Hills and about 60 miles on the dominion side of the boundary line. This trading post they have named Fort Hamilton, after the mercantile firm of Hamilton, Healy, and Company, of Fort Benton, Montana, United States, from whom it said they obtain supplies. It is believed that they number about 20 well-armed men, under the command of a man called John Healy, a

notorious character. Here it appears they have for some time carried on an extensive trade with the Blackfeet Indians, supplying them with rifles, revolvers, goods of various kinds, whisky, and other ardent spirits, in direct opposition to the laws both of the United States and the dominion of Canada, and without paying any custom duties for the goods introduced into the latter country. The demoralization of the Indians, the danger to the white inhabitants, and the injury resulting to the country from this illicit traffic, are very great.

It is stated upon good authority that during the year 1871, 88 of the Blackfeet Indians were murdered in drunken brawls amongst themselves, produced by whisky and other spirits supplied to them by those traders. Year after year, these unscrupulous traders continue to plunder our Indians of their buffalo robes and valuable furs by extortion and fraud, and the shameful traffic causes certain bloodshed amongst the Indian tribes. At Fort Edmonton during the past summer, whisky was openly sold to the Blackfeet and other Indians trading at the Post by some smugglers from the United States, who derive large profits thereby; and on these traders being remonstrated with by the gentlemen in charge of the Hudson's Bay Post, they coolly replied that they knew very well that what they were doing was contrary to the laws of both countries, but as there was no force there to prevent them, *they would do just as they pleased.* It is indispensable for the peace of the country and welfare of the Indians, that this smuggling and illicit traffic in spirits and fire-arms be no longer permitted. The establishment of a custom-house on the Belly River near the Porcupine Hills, with a military guard of about 150 soldiers is all that would be required to effect the object. Not only would the establishment of a military post here put a stop to this traffic, but it would also before long be the means of stopping the horse-stealing expeditions carried on by hostile Indians from south of the line into Dominion territory, which is the real cause of all the danger in that part of the country, and the source of constant war among the Indian tribes.

Indeed it may now be said with truth, that to put a stop to horse-stealing and the sale of spirits to Indians, is to prevent altogether Indian wars in the north-west. The importance of the Porcupine Hill in a strategical point of view is very great, commanding as it does the entrance of both the Kootanie passes towards the west, and the route from Benton into the Saskatchewan territory on the south and east; the country can be seen from it for immense distances all round. Although hostile to citizens of the United States, it is believed that the Blackfeet Indians would gladly welcome any Dominion military force sent to protect them from the incursions of other tribes, and to stop the horse-stealing which has for so long been carried on. With excellent judgment they have pointed out the southern end of the Porcupine Hill as the proper place for a military post. In order to satisfy myself on this point, I spent the greater portion of the 29th September in reconnoitring the ground recommended by them, and if it be the policy of Government to take steps to stop the illicit smuggling which is being carried on at this part of the Dominion, there is every convenience for establishing a custom-house and military post. Timber

of large size and good quality for building is close at hand; and the surrounding country is most fertile and favourable for settlement.

The distance from Fort Edmonton to the Porcupine Hill is about six or seven days' journey on horseback, and from the Kootanie Valley on the western side of the Rocky Mountains, from whence supplies could be easily obtained, about fifty or sixty miles.

Frequent intercourse, and an active trade between the Kootanie district of British Columbia and the Saskatchewan country, would result from the establishment of a custom-house and military post at the Porcupine Hills. Many individuals are prepared to settle there, if any protection is afforded, and the Indian trade of the country, at present tapped by United States' smugglers, would remain with our own countrymen. There is a general belief prevalent, moreover, that valuable gold deposits are to be found near the Porcupine Hills; the unsettled state of the country hitherto has not admitted, however, of much prospecting. A party of four American miners who crossed through the Kootanie Pass two or three years ago, were all killed by the Blackfeet, near the Porcupine Hill, the moment they entered the plain on the eastern side; since which no attempt at prospecting for gold has been made in that part of the country.

With regard to the measures which should be adopted for the settlement of the country, I feel satisfied that the introduction of a civil police force, unsupported by any military, into the Saskatchewan territory would be a mistake, and that no time should be lost in establishing a chain of military posts from Manitoba to the Rocky Mountains. The appointment of a stipendiary magistrate for the Saskatchewan, to reside at Edmonton and act as the Indian Commissioner, is also a matter of the first importance. The individual to fill this important post should be one, if possible, already known to, and in whom the Indians have confidence. I consider that it is very necessary to invite the co-operation of the Hudson's Bay Company in the adoption of any steps towards establishing law and order in the Saskatchewan for the first few years, and no Indian Commissioner should proceed unaccompanied by a military force. A large military force is not required, but the presence of a certain force I believe will be found to be indispensable for the security of the country, to prevent bloodshed, and preserve peace.

The number of the Indians dwelling in the extensive country which lies between the Red River and the Rocky Mountains on Dominion territory has been much exaggerated. It is very difficult to arrive at any accurate Indian census, but having made every inquiry during last summer on this point, whilst travelling through the country, from those most competent to judge, I doubt if there are more than 4,000 Prairie Indians capable of bearing arms in the Dominion territory, between Fort Garry and the Rocky Mountains, south of the Sub-Arctic Forest, and north of the International Boundary Line, the total Prairie Indian population amounting, perhaps, to 14,000 or 15,000. These Indians are scattered over such an immense extent of country that anything like a formidable combination is impossible; most of the tribes, moreover, have been hostile to one another from time immemorial.

It is believed that the Blackfeet and the Plain Crees, the two

strongest tribes of Prairie Indians, may have respectively about 1,000 fighting men, but it is doubtful if either tribe could ever concentrate such a number, or if concentrated, that they could long remain so from the difficulty of obtaining subsistence. Although many of the Blackfeet have breech-loading rifles, the Indians generally are poorly armed and badly mounted. Under these circumstances it will be readily understood that comparatively small bodies of well-armed and disciplined men judiciously posted throughout the country, could easily maintain military supremacy. A body of 50 mounted riflemen armed with breech-loading rifles is a formidable power on the prairies.

One regiment of mounted riflemen, 550 strong, including non-commissioned Officers, divided into companies of 50, would be a sufficient force to support Government in establishing law and order in the Saskatchewan, preserving the peace of the north-west territory, and affording protection to the surveyors, contractors, and railway labourers about to undertake the great work of constructing the Dominion Pacific Railway.

Although the proposed military strength, and consequent expense, may appear somewhat considerable, I have been guided by every consideration of economy in recommending the above number. It is wiser policy and better economy to have 100 soldiers too many, than one man too few; the great extent of the country, and detached nature of the service, must also be taken into account, and it should be borne in mind that the only thing the Indians really respect and will bow to, is *actual power*. It should be borne in mind too, that in addition to the Indian element, there is a half-breed population of about 2,000 souls in the Saskatchewan, unaccustomed to the restraint of any government, mainly depending as yet upon the chase for subsistence, and requiring to be controlled nearly as much as the Indians. If it be in harmony, therefore, with the policy of the Government to do so, I would recommend the establishment of military posts at the following places, strength as below:—

Mounted Riflemen.

1. At Portage de la Prairie, 50; 2. at Fort Ellice, 50; 3. at Fort Carlton, 50; 4. at Fort Pitt, 50; 5. at Fort Victoria, 50; 6. at Fort Edmonton, 100; 7. at Porcupine Hill, 150; total, 500. With a proportion of Officers and non-commissioned officers.

If no permanent custom-house and military post is established at the Porcupine Hills, then the strength of the force at Edmonton should be 250, of which 150 men should be encamped during the summer months at the Porcupine Hills, or at the junction of the Bow and Belly rivers, returning to Edmonton for the winter; but the establishment of a custom-house and military post at Porcupine Hills, is of far more importance, and would have a much better general effect towards securing the peaceful settlement of the country than at any other places named. During the summer months a detachment of 50 men from this post might with advantage be employed in improving the communication across the mountains with the Kootanie district of British Columbia.

It would be necessary that each of the companies of mounted riflemen should be made, as far as possible, self-supporting communities, provided with a few carts, entrenching tools, agricultural implements, seed for raising corn, and some cattle. These military posts would partake of the character of military settlements, in the vicinity of which many settlers would, ere long, establish themselves.

It would be very desirable, moreover, that a medical officer should be appointed to each military post, and his duties not confined to the medical charge of the military only, but extended to all the Indians in the vicinity. Past experience has proved that no measure is better calculated to secure the confidence and attachment of the Indian tribes than by attending to their wants in time of sickness, and supplying them with medical aid.

The men to compose the corps should be enlisted to serve for three years, receiving on the termination of the engagement (provided they have performed their duties in a satisfactory manner), the same amount of land as is granted on discharge to the men of the militia in Manitoba; I would recommend that the corps be raised by volunteers from the active militia. It would be desirable to attach to the military force at each post, three or four half-breeds, or Indians, as scouts, who could serve as interpreters, and would usually carry the mail.

At the places indicated for military posts, no great difficulty would be experienced, or expense incurred, in hutting the men, they themselves performing the work, or an arrangement might be more easily made with the Hudson's Bay Company to provide barrack accommodation and rations at the different posts for the number of men required.

In the event of this proposed arrangement meeting with the views of Government, I have the honour to state that the probable expense that would be incurred for the establishment and maintenance of the militia force proposed, would be about 300,000 dols. annually.

I would further beg to suggest, if it be decided to establish any chain of military posts, that for the first year the soldiers be employed in laying down a telegraphic wire from Manitoba towards British Columbia, if not required to hut themselves.

From my own knowledge and observation of the country, I think that if proper energy be used, the very desirable work of establishing telegraphic communication, from Fort Garry through Dominion territory, with British Columbia, could be carried out by the soldiers in one or two seasons. I would further observe that no time should be lost in making the preliminary arrangements. The men and horses should, if possible, be concentrated at Fort Garry in the month of May or June, their equipment forwarded sooner, and the companies despatched without delay. An easy and agreeable march of a few weeks' duration would suffice to establish them in the respective posts of occupation.

BRITISH COLUMBIA.

With regard to the organization of the militia in British Columbia, it is recommended that one Staff Officer as Deputy Adjutant-General of Militia be appointed for the province, as soon as the Government

finds it convenient to do so. It is not necessary at present to appoint Brigade Majors.

The formation of two companies of riflemen (volunteer militia) in Victoria, and one at Nanaimo, is recommended, also the formation of one company of riflemen at New Westminster, another at Burrard's Inlet, on the mainland, and that the New Westminster battery of garrison artillery be reorganized.

The total white population of the province is only as yet about 12,000. There are about 4,000 half-breeds and 45,000 Indians—the latter mainly dwelling along the coast. The Indians dwelling in the interior of British Columbia are not numerous; the policy of treating them much in the same manner as if they were settlers, appears to have succeeded admirably.

The following amount of military stores have recently been despatched by order of the Dominion Government, from England direct by sea to Victoria, for the equipment of the militia of the province:—

1,000 Snider Enfield rifles.
1,000 sets of accoutrements.
1,000 rifle uniforms.
1,000 great coats.
300,000 rounds of ammunition.
60 tents.
20 targets complete, with flags.
100 camp kettles.
1,000 knapsacks complete, with mess tins and straps.

It is very desirable with a view to ultimate economy as well as present efficiency, that some building be acquired in Victoria to serve as an armoury and storeroom, and that a storekeeper be appointed to the charge of this public property without delay.

I submit, with this Report, a map of the north-west provinces and territories of the Dominion, showing the route which I followed across the continent; the places recommended for military posts are marked, and the point where it is stated that United States' smugglers have established a post at the junction of the Bow and Belly Rivers, is also shown.

The portion of territory north of the 49th parallel, and west of the Lake of the Woods, on the "Dawson Route" now claimed by the United States' authorities, and which intersects the present Canadian line of communication with Manitoba and the important territories of the north west is shaded dark.

I have the honour to be, Sir,
Your most obedient servant,
P. ROBERTSON-ROSS,
Colonel Commanding the Militia of Canada,
and Adjutant-General of Militia.

Head-quarters,
Ottawa, 17th March, 1873.

This Report has been submitted to the Dominion Parliament now in Session.

P. R. R.

Evening Meeting.

Monday, March 31st, 1873.

Major-General SCHOMBERG, C.B,, R.M.A., Deputy Adjutant-General Royal Marines, in the Chair.

NAMES of MEMBERS who joined the Institution between the 26th and 31st March, 1873.

ANNUAL.

Cotton, C. McClintock, Major 20th Hussars.
Carr, Fredk. S., Captain 5th Punjab Cavalry.
Hayter, A. D., Lieut.-Colonel London Rifle Brigade.
Maxwell, Patrick, Lieut.-Colonel Bengal Staff Corps.

OBSERVATIONS ON THE MONCRIEFF SYSTEM OF MOUNTING ORDNANCE.

By Lieutenant T. English, R.E.

In the paper which I have the honour of reading to-night, I do not propose to enter into any of the mechanical questions connected with Major Moncrieff's invention, but only to consider the subject from the point of view of an engineer, who has to fortify a given position. In such a case, one of the first things to be done is to determine what is the best type of works to erect, and it is to this problem, more particularly with regard to coast defence, that I would call your attention.

At the outset of my paper, too, I would carefully guard myself against offering an adverse opinion on the merits of Major Moncrieff's or of any analogous system, as applied to mounting ordnance on works intended to resist land attack, and where earth is the only material available.

In unstrengthened earthen parapets, the embrazure system becomes more and more dangerous, as the power of rifled shell-guns grows larger. The objections to it are too many and too well known to be worth repeating; and it seems likely that some barbette system, with an unbroken parapet, must be substituted for it. Major Moncrieff's carriage, although it does not reduce the target presented to high angle fire, still allows of so much more horizontal protection than the ordinary barbette carriage, as, wherever its use is practicable, fully to compensate for the extra weight, cost, and complication involved.

For coast defence, however, the arguments both for and against the adoption of Major Moncrieff's system of mounting ordnance, have generally been founded upon the ideal case of a duel between a single gun in a shore-battery and a single gun on board ship; and too little consideration appears to have been given to the various powers of offence of a powerful fleet.

It would, therefore, seem desirable to examine, more closely than has hitherto been done in public, into the conditions which probably would prevail in the attack from the sea, of a harbour or channel, defended by heavy guns and torpedoes.

The risk of loss and disaster, in making such an attack, is, from unavoidable causes, so great, that the enterprize is not likely to be begun unless the command of the sea has been obtained; whilst the most careful preparations will be made before hand, and the means of attack will be so proportioned to the known powers of the defence, as to give, at least, a fair chance of success; unless, indeed, the invader's object be defeated by such defensive arrangements having been made, as will evidently render the position practically impregnable.

To fix the ideas, assume the position to be that of a tidal channel, with a width of half a mile to a mile of deep water, low banks, and reaches from one to three miles long, with bends approaching right angles between them.

Assume also, that forty heavy guns are available for the defence, twenty of them being of twelve-inch, and twenty of ten-inch calibre, and that a complete system of torpedoes has been laid down.

It will, I think, be the general opinion of those who have studied the subject, that, to reduce such a position, if properly defended even by artillery fire alone, would require a fleet carrying at least the same number of heavy guns.

We may, therefore, assume that the attacking force must consist of, at least, four turret ships of the heaviest type, each carrying four twelve-inch guns, or their equivalents, and protected by twelve or fourteen inches of iron, so as to be practically invulnerable at moderate ranges, and only to be disabled by shot entering the ports, or by the turrets being jammed.

These vessels would be supplemented by, say, six broadside sea-going ships, of moderate armour, seven or eight inches thick, but strengthened and prepared, for this special duty, by taking out their masts and all superfluous weights, and by adding extra plating along their waterlines and batteries, so as to bring their resisting power at the most vital parts, on a par with that of the turret ships.

Each of these vessels may be assumed to carry eight ten-inch guns, four on each broadside; and two ships of their number would be kept in reserve.

The fleet would still require unarmoured gun-boats of light draught, say fifty in number, twenty to be kept in reserve; each of two hundred or three hundred tons, and carrying two nine-inch rifled howitzers or their equivalents, capable of being trained into any position, though only one would probably be used at a time.

Hence we have an attacking force, which can be concentrated on any point, of

	16	12″ guns in four turret ships,
	16	10″ guns in four broadside ships,
	30	9″ howitzers in thirty gun-boats,
Total	62	pieces of ordnance;

and of the thirty-two guns above enumerated, it must be remembered that any can be replaced by howitzers, if required.

Even putting torpedoes on one side for the present, as having been removed or destroyed, an attacking force cannot afford either to neglect heavy batteries or to attempt to pass them, silencing them only for a time; for, unless they are totally destroyed and occupied, they will form a complete obstacle to the maintenance of communications and supplies, and, by the facilities they would offer, if not taken, for the re-establishment of torpedoes, (the removal of which must be a work of time,) they might seriously compromise the safety of the attacking fleet, in the event of a retreat being from any cause necessary. But the use of torpedoes has improved the defence, and considerably altered the conditions of the problem, by compelling the enemy to take up a definite position, chosen by the defenders; that is, in the water from which the torpedoes can be removed or destroyed without the possibility of re-laying.

This water-space would include all within view of the hostile fleet and under the fire of its guns, whilst the fleet keeps out of range from the forts. Where bends in the channel, or the forts themselves, prevent a view from the fleet, it is not likely that much difficulty will exist in renewing torpedoes, even if removed.

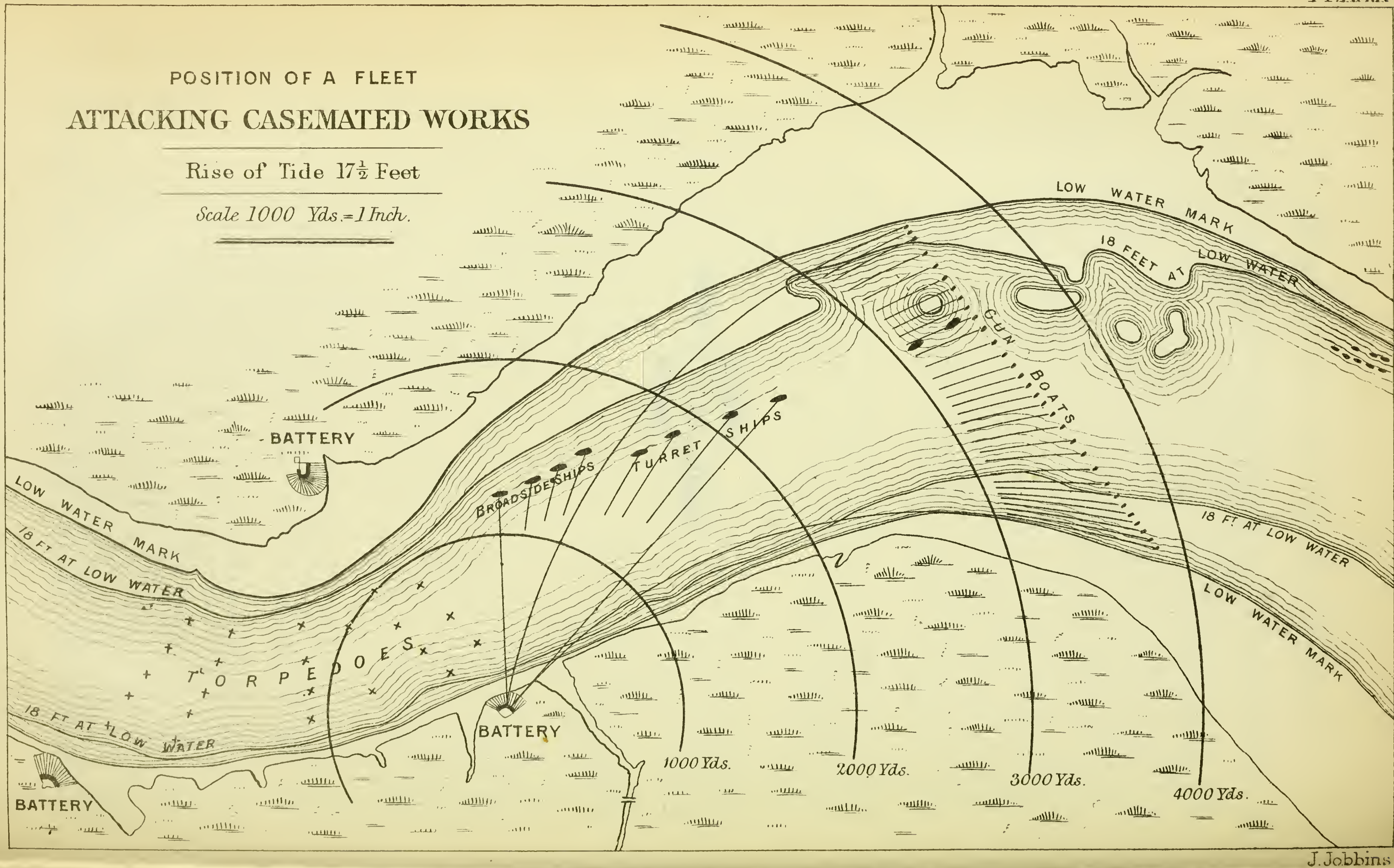
I should conceive that the plan of operations would be somewhat as follows:—The fleet would anchor at a safe distance below the batteries, and probably spend several days in clearing away torpedoes, by sending gunboats and steam launches, whenever darkness permitted, either to pull them up, to cut the cables, or to explode them in place.

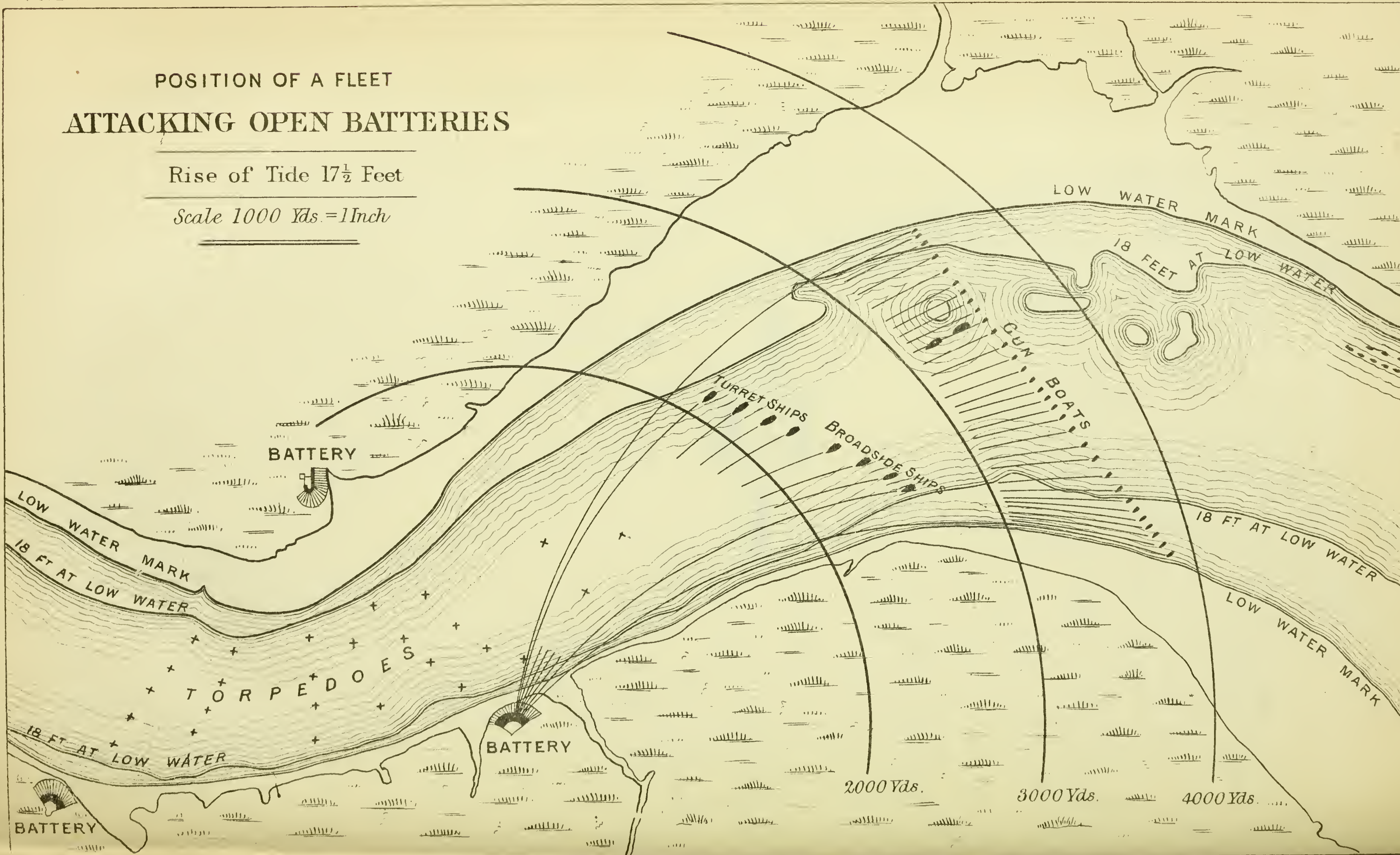
Some of the armoured vessels would advance at daylight, to within long range of the works, so as to prevent, by their fire, any possibility of torpedoes being re-laid; retiring at dusk to a safer anchorage, and to give place to the boats.

By these means a channel could probably be cleared of all sub-marine obstructions, in the course of three or four days, to a distance sufficient to allow the fleet to take up its position for attacking the batteries; the limit of clearing being, as before stated, where the channel stretched out of range and sight of the fleet. Probably several, and possibly many boats and small vessels would be lost during these operations, but it would appear to be out of the power of the defenders to do more than hinder them.

If the channel could not be cleared in the manner indicated, it would appear certain that the expedition must fail, for no Commander would, I think, dare to carry his ships through a narrow channel where torpedoes were known to exist.

The attack in force would obviously be varied according to the nature of the defence to be overcome; but, assuming first that the guns on shore were mounted in casemates, I should imagine that the most effective and formidable method of attacking would consist in the armoured fleet advancing, against the tide, in single column, through the channel cleared of obstructions, until nearly abreast of the lower-most works; when, as in the bombardment of Fort Fisher, in the American war, they would drop anchor at about 200 yards distance


POSITION OF A FLEET
ATTACKING CASEMATED WORKS
Rise of Tide 17½ Feet
Scale 1000 Yds.=1 Inch.
LOW WATER MARK
18 FEET AT LOW WATER
18 FT AT LOW WATER
GUN BOATS
TURRET SHIPS
BROADSIDE SHIPS
TORPEDOES
BATTERY
BATTERY
BATTERY
1000 Yds.
2000 Yds.
3000 Yds.
4000 Yds.
J. Jobbins


POSITION OF A FLEET
ATTACKING OPEN BATTERIES
Rise of Tide 17½ Feet
Scale 1000 Yds. = 1 Inch
LOW WATER MARK
18 FEET AT LOW WATER
GUN BOATS
TURRET SHIPS
BROADSIDE SHIPS
18 FT AT LOW WATER
LOW WATER MARK
BATTERY
LOW WATER MARK
18 FT AT LOW WATER
TORPEDOES
18 FT AT LOW WATER
BATTERY
BATTERY
2000 Yds.
3000 Yds.
4000 Yds.

J. Jobbins.

apart, the column taking up about a mile in length. They would then concentrate all their fire, by signal, with battering charges, upon one of the works furthest down the channel, at ranges varying from 1,000 to 2,500 yards (see Plate xxix). When the guns attacked were silenced, the fire of the whole fleet would be transferred to the next, and so on; some of the vessels weighing anchor and taking up fresh positions, if required.

At the same time, the gunboats will have followed the heavy ships at a considerable interval, and will have kept up a continuous fire of shells, at as close a range as they could venture to without drawing fire upon themselves, say from 3,000 to 4,000 yards, upon the same guns with which the ships were engaged.

If, instead of casemated works of defence, open batteries were to be engaged, I imagine that much the same general method of attack would be followed, except that the fleet would come to an anchor at a considerably greater distance from the works, say the nearest vessel being 2,000 yards from the outermost battery, and would commence a high angle shell fire on each work in succession, until silenced, the ships moving up into fresh positions, as required (see Plate xxx).

Such being the conditions of attack, it remains to be considered what disposition of guns is likely to give the most effective defence.

It is clear that the more the available guns are distributed along the banks of a channel, the less obstacle will each one present to the systematic carrying out of the process of silencing them described above; for, with a number of detached guns, or small works defending a channel, the enemy will gradually advance, clearing away the torpedoes and reducing the batteries singly, with comparative ease.

The cardinal principle of the defence would therefore appear to be, to concentrate such a weight of fire—not on one point only, but upon the whole position which the attacking fleet is compelled, by the presence of torpedoes, to occupy, that is, upon a front a mile long—as shall silence the enemy's guns in the shortest possible time. If such a defensive position is taken up, the enemy cannot bring any of his ships within range close enough to do much harm to the batteries, until the time he may choose, after much preparation, for a combined effort with his whole strength, when many circumstances may occur to prevent his success.

Assuming, however, that the ships are brought into the position described for commencing the attack, it will clearly be not worth while for the batteries to waste ammunition upon gun-boats at extreme ranges: they would seldom be hit, and if all were sunk or disabled, it would not decide the fate of the action; but if the heavy vessels can be silenced, the gun-boats will be incapable of further harm.

As more experience is gained in the manipulation of heavy ordnance, it appears more and more certain, that where a number of guns are to act in concert, it will be necessary to control and direct their fire from signal stations at a distance, free from the smoke and confusion which must exist in a battery of any sort; and this circumstance will exercise a powerful influence upon the tactics of the defence. For, as it will be impracticable, for obvious reasons, to signal separately to

each gun, it follows that a battery must be divided into sections, all the guns in one section concentrating their fire upon one object, of which the range and direction are communicated and corrected from the signal station.

We may therefore assume that, in the case under consideration, the forty guns in battery would be divided into eight sections of five guns each. It will be impolitic to concentrate the fire of all the sections upon one ship, as might at first sight seem desirable, for the reason that the value of fire from a land-battery is entirely different from that from a fleet. On shore, with a steady platform, it is possible to correct each shot by the previous one, and so to throw nearer and nearer the object until the errors of aim are eliminated, or nearly so; on board ship, however, the unavoidable motion, caused even in still water, and at anchor, by the recoil of the guns, is sufficient to prevent much advantage in aiming being taken of the results of previous rounds, and the object of a fleet will be to concentrate its whole weight of fire as nearly as possible on one spot, so as to ensure some shots taking effect; and even if this be done, the fire will be more than sufficiently scattered, whilst if it were distributed over the whole position attacked, the results would, I think, be small indeed.

It would seem best, that the fire of any section of the batteries should be continuously directed against the same gun on shipboard, until it is silenced, and by this means the fleet will be most speedily disposed of. But the fire of only one section should be directed against each ship, for otherwise it would be impossible for an observer to correct the aim of the section which he was controlling, as he would not be able to identify the results of its fire.

It will, I think, be next to impossible to sink a ship protected by twelve or fourteen inches of iron, during action, in smooth water, by artillery fire; few, if any, shot would enter below the water-line, and the resistance of armour increases so rapidly with the angle of impact, that it will not be worth while to attempt to do more than to disable the guns, and this would appear to be most readily effected at short ranges, by firing Palliser projectiles at the ports.

As it is plainly desirable, that besides concentrating the guns upon a front, say, a mile in length, the batteries should prevent as much as possible of the channel above them from being seen by the enemy; and as, from what has been already advanced, it appears that torpedoes have put it in the power of the defenders to choose their own ground, it will be best to occupy a bend in the channel, other things being equal, rather than part of a straight reach.

From the foregoing considerations, it will be seen that unlimited lateral range is not of vital importance to shore batteries; the guns are placed to defend a certain definite position, each has its own work to do, and can do it without firing all round the circle; for, from the impossibility of more than one ship occupying the same water at one time, the guns of a fleet cannot be, upon the average, less than fifty yards apart, and a moderate amount of lateral range will enable the batteries to employ their guns to advantage in all positions the ships can take up.

The one advantage of extreme lateral range is to provide against the rather improbable case of one or of a small number of vessels attacking a number of heavy batteries; they would certainly be silenced in a time, diminishing in proportion to the number of guns which could be brought to bear upon them; but it is scarcely worth while to discuss this case, for, judging from every successful sea-attack hitherto carried out, the number of vessels in a fleet designed to attack shore batteries, will always be considerable.

The expense of foundations, gorge buildings, and other accessories, presents an insuperable obstacle to the otherwise desirable plan of spreading the guns about as much as possible, within the limits of being able to concentrate upon a fleet, and it is, I think, quite impracticable to get over this difficulty by planting guns about in the mud, without any foundations at all, as has been proposed.

It should also be remembered that the cost of foundations is a necessary evil, which does not add in the slightest degree to the offensive power of a battery, and should be kept down as much as possible.

Assume, therefore, that three sites are chosen, on which to mount forty guns. It will be advisable to have guns on each side of the channel, for it will clearly be the better for the defence, whether casemates or open batteries are used, to compel the fleet to approach as close to the works as possible. Twenty guns may then be taken as placed in a battery, at a point where the shore forms a salient angle, and ten guns in each of two batteries in the corresponding re-entering angle formed by the opposite shore.

It will, I think, be impracticable to hide the whereabouts of a heavy gun in action;—it is possible, no doubt, completely to screen its exact position until firing commences, but it will be within every one's observation that the puff of smoke, produced by the discharge of a heavy gun, is one of the most prominent objects in any landscape; also, at any rate in this country, with the publicity afforded by the newspaper press to every detail of the defences, it would probably be found, in the event of war, that the position and nature of every gun was carefully laid down on the large scale charts of the estuaries and harbours, with quite sufficient accuracy to ensure the range and direction being known, within 50 yards, from any position a vessel could take up.

It may be estimated that the guns of the fleet all being concentrated upon one spot, the fire would converge through a horizontal angle of from 60° to 90°, and might descend at angles with the horizon, varying from say 50° to 3°.

Having arrived at this point in the problem, the difficulty arises that, if cover overhead is given against such a bombardment, the protection in front must be, to some extent, reduced to enable the gun to fire, as in a shield with a port; whilst if the protection in front remains intact, as in a barbette battery, the overhead cover must be abandoned altogether.

It will, therefore, be necessary now to examine which of these two systems will give theoretically the best resistance, assuming that each is attacked by the description of fire most dangerous to it.

Taking first the case of a casemate fitted with an iron shield, or of an open battery fitted with a similar shield and overhead cover;—in the absence of data which can only be provided by the experience of an actual bombardment, it will be evidently a waste of time to speculate as to the probable area covered by the fire of the whole fleet. We can, however, by the help of the reports of practice carried out for range and accuracy, form a good estimate of what any piece of ordnance can do under the conditions most favourable to it, and for purposes of comparison of the defensive powers of two systems, as measured by the offensive powers of the most dangerous fire that can be brought against each, I think we can arrive at sufficiently accurate conclusions.

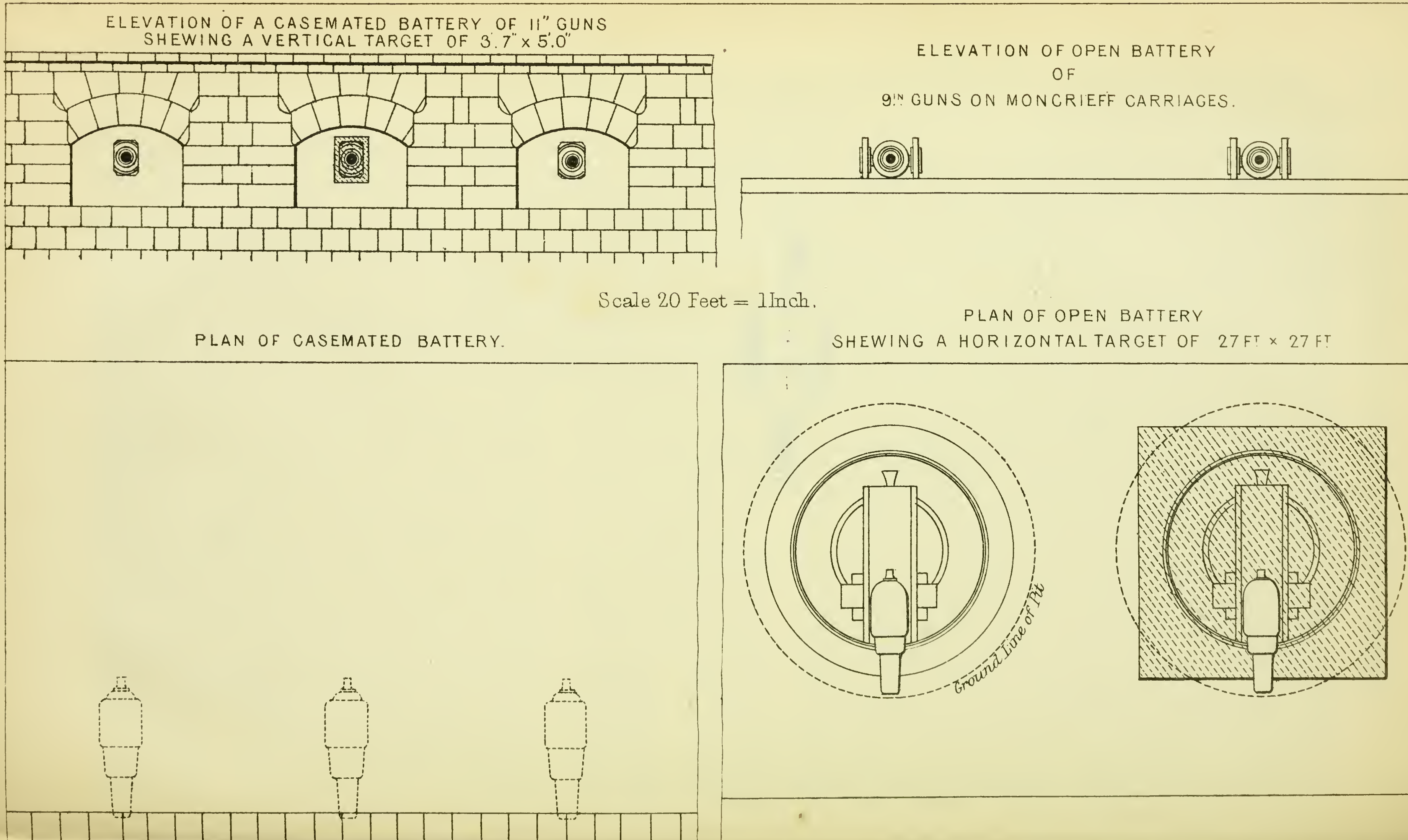
It may be assumed that the vulnerable parts of a casemated work protected by iron shields, consist of the ports through which the guns fire, and of a certain margin round them. (See Plates xxxi, xxxii). This margin I have taken as six inches, for the reason that, in the trial of the sample iron shield, No. 31, at Shoeburyness, in March, 1870, a ten-inch Palliser shot which struck seven inches from the edge of the port, went straight into the substance of the shield, not being influenced in any way by the near neighbourhood of the opening. As the port may be taken to be a rectangle of 2′ 7″ + 4′ 0″, the greatest vertical target presented by it and the margin round it may be considered as a rectangle of 3′ 7″ × 5′ 0″, the breadth diminishing with the horizontal angle of impact.

In Table I annexed, will be found the chances against striking such a rectangular vertical target from a steady platform with various natures of guns, at various known ranges, as calculated from the series of rounds fired for range and accuracy at Shoeburyness.

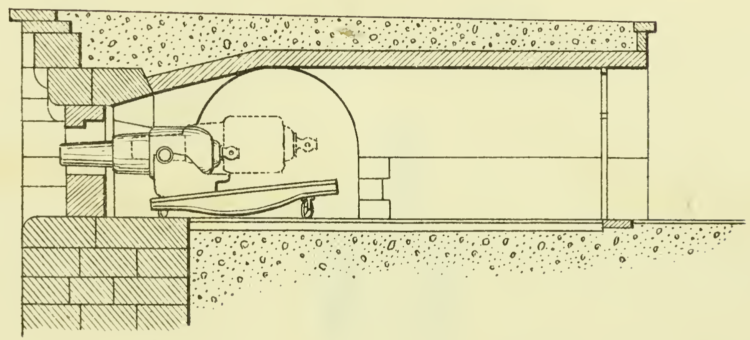
From the table we see that the most dangerous fire is from the ten-inch gun with battering charges at short range; and that high angle fire at all ranges is extremely ineffective, the chances ranging from 388 to 1 against striking such a target at a range of 1,037 yards, up to 7,816 to 1 at a range of 4,676 yards.

But, on board ship, even though the range be known, the unavoidable motion will cause a certain error of elevation, and consequently the chance of striking, is not ever likely to be so great as above described. In almost the only experiment with heavy ordnance bearing on the subject, the attack by the "Hotspur" upon the "Glatton," at Portland, the mean vertical deviation under most favourable circumstances could not be taken as much less than three feet at 200 yards; this corresponds to a mean difference of elevation of plus or minus a quarter of a degree. If the mean differences of range in Table I are corrected accordingly, the results shown in Table II will be obtained, and will, I think, represent as accurately as in the present state of our knowledge it is possible to do, the greatest effect to be obtained, under favourable circumstances, from guns mounted on board ship.

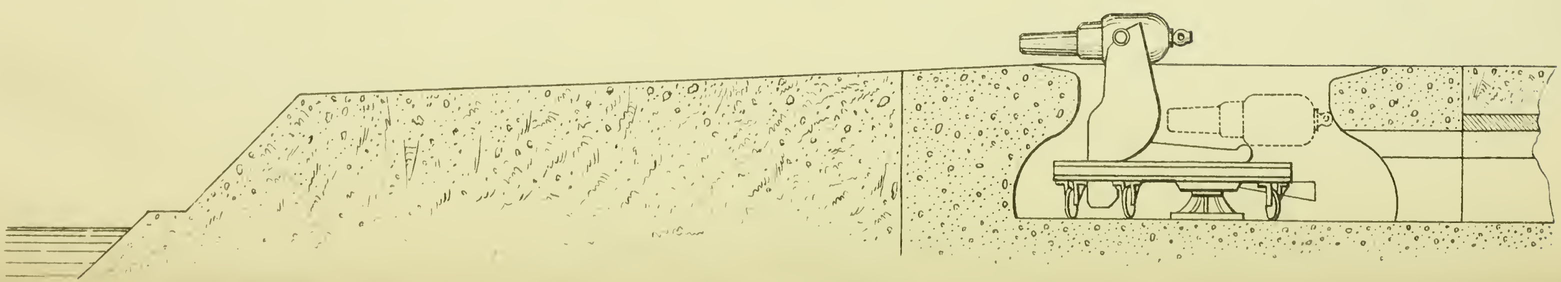
It is clear that small differences of elevation, with a given range, produce much less effect on firing at a high elevation and low velocity, than on firing with a low elevation and high velocity; and, accordingly, we find that the chances against striking a vertical target 3′ 7″ × 5′ 0″ with the eight-inch howitzer at 1,037 yards range, are only increased from


ELEVATION OF A CASEMATED BATTERY OF 11" GUNS
SHEWING A VERTICAL TARGET OF 3'.7" x 5'.0"
ELEVATION OF OPEN BATTERY
OF
9.IN GUNS ON MONCRIEFF CARRIAGES.
Scale 20 Feet = 1 Inch.
PLAN OF CASEMATED BATTERY.
PLAN OF OPEN BATTERY
SHEWING A HORIZONTAL TARGET OF 27 FT × 27 FT
Ground Line of Pit

SECTION OF A CASEMATED BATTERY OF 11" GUNS.



SECTION OF OPEN BATTERY
OF
9IN GUNS ON MONCRIEFF CARRIAGES.



Scale 20 Feet = 1 Inch.

J. Jobbins

388 to 1 up to 480 to 1, and at 4,676 yards range from 7,816 to 1 up to 9,730 to 1; whilst the chances against striking with the ten-inch gun are raised at 1,750 yards range from 6·3 to 1 up to 48·3 to 1, and at 2,490 yards range from 10·7 to 1 up to 94·7 to 1.

Still, however, the danger from battering charges is so much the greater, that we may reasonably conclude that subjection to such a fire will be the most trying ordeal to which a shield can be put; and that the plan of attack will be, as previously stated, for the armoured fleet to take up a position as close as possible to the works, and pour in a heavy fire of Palliser projectiles with battering charges.

The gun-boats attached to the fleet would no doubt keep up a shell fire, at a safe range, to disturb as much as possible, by smoke and splinters, the service of the guns in battery; but their chances of doing injury to the men working the guns, or to the guns themselves, are very small; and the effective result of the attack on the works will be almost entirely confined to the projectiles entering a port or striking close to one. It may be said that other parts of a shield will be penetrated, but there is certainly now no difficulty in making every part equally strong, and, whatever may be advanced to the contrary, I am convinced that all the shields yet made in this country, for exposed positions, are totally impervious to any battering which they could receive in action, with the exception of the ports, and of a six-inch margin round them.

The remainder of the front of a work which is not near a gun, and therefore not limited in thickness, can readily and cheaply be made of any strength thought necessary.

Guns in casemate, even when in action, are protected when in the loading position from any fire except in the direction to which they are pointing, and the mantlets fitted up in all casemates will, it is believed, give complete immunity from all splinters inside.

Next, in the case of a barbette battery made of earth or concrete, a comparison may be arrived at as follows:—

Neglecting the vertical target presented, the size of which is a disputed point, an emplacement for a nine-inch gun, *en barbette*, may be considered to present a horizontal target of twenty-seven feet by twenty-seven: these are very nearly the dimensions at the ground level of the emplacement for a nine-inch gun mounted on Major Moncrieff's system at Shoeburyness; and, for high angle fire from any direction, will give, approximately, the dangerous area exposed. (See Plates xxxi, xxxii.) For direct fire the size of target is more difficult to arrive at, as a shot descending at a small angle behind the crest of the pit would not have much effect; but, on the other hand, a shot striking the parapet at some distance from the crest will be dangerous; and, on the whole, it appears fair to consider the horizontal target, in this case also, as equal to the ground area of twenty-seven feet by twenty-seven.

By a similar reference to that already made to the results of rounds fired for range and accuracy, in Table III, it will be seen that, from a steady platform, the chances against the fire from the eight-inch howitzer striking a horizontal target twenty-seven feet by twenty-seven, are from 10 to 1 at 1,037 yards range, up to 139 to 1 at 4,676

yards range, whilst with direct fire the greatest danger is from the ten-inch gun at 2,490 yards range, when the chances against striking are 4·7 to 1.

But, allowing as before for a mean error of elevation of $\frac{1}{4}°$, as in Table IV, the probabilities become reversed; for whilst the chances against striking with direct fire reach 46·5 to 1 with the ten-inch gun at 2,490 yards, the chances with the eight-inch howitzer are only increased to 12·6 to 1 at 1,037 yards, 32·5 to 1 at 2,671 yards, and 174 to 1 at 4,676 yards.

From these results it is plain that the greatest effect against open batteries will be obtained by a high angle shell fire, and that very good results can be obtained at long ranges. Taking therefore into consideration the much less chance of injury to vessels from the fire of a fort, if they are kept as far off as possible, consistently with their own fire being effective, and end on, as they probably can be for working howitzers; we may conclude that what is to be feared in an open battery is the fire of shells projected at a high angle of elevation such as 40°, from ranges of say 2,000 to 4,000 yards.

Much has been said as to the evil effect of ports in limiting the training of guns firing through them, but in any case similar to that under consideration it does not appear that guns require more than a moderate training, and it has, I think, been entirely overlooked that guns in casemates are completely protected until brought into action; it is impossible to give any equivalent protection in an open battery; something, but not much, can be done by raising the merlons, but I should regard it as a positive evil to give a gun more training than was absolutely necessary, having regard to all the conditions of the case.

In comparisons which have been made between an emplacement for a nine-inch gun on Major Moncrieff's system and an open battery shield, it should be remembered that no such thing as an open battery shield, in the strict sense of the word, exists or is likely to exist in the British possessions; all shields which are not casemated are prepared for the reception of overhead cover for the men and gun, and many are furnished with it already. It would take but a short time to completely cover the whole number, and the sole reason why this has not been done already is, that it is far preferable to keep the material for the covering, consisting in great part of timber, in store, rather than to let it decay *in sitû.*

The protection of these so-called open battery shields is quite as good, when in good order, against a short bombardment, as that afforded by a casemate; and out of a total number of 397 guns in England, now protected or authorised to be protected by armour, the number behind such shields is 18.

As regards the cost of the two systems, when casemates are employed, it will be found that many more heavy guns can be mounted upon the same foundations, than by the use of open batteries; and the extremely variable cost of foundations in different sites, therefore, prevents any good comparative estimate being made between the cost per gun of a casemated work and of an open battery.

An open battery fitted with shields, however, and one adapted for

Major Moncrieff's carriages, would require substantially the same foundations; but a nine-inch gun-pit cannot fairly be compared with a shield which has been found by direct experiment to be completely proof against the 25-ton gun, and as far as can be known in the absence of actual trial, is believed to be proof against the 35-ton gun at any range.

Surely, the comparison should rather be made with a shield only capable of resisting nine-inch guns or their equivalents, for it is not to be supposed that nine-inch guns will usually be employed on shore against anything heavier at sea.

If this is admitted, the comparison will stand as follows, neglecting open battery shields without overhead cover as incomplete:—

	£
Moncrieff's 9″ pit, with expense magazine, say	1,070
Moncrieff's 9″ carriage, pattern II, say ..	1,340
Total	£2,410

And—

	£
Open battery emplacement, with expense magazine, shield with 10″ armour and overhead cover, say	2,200
Service 9″ casemate carriage and platform, say	350
Total	£2,550

But it will probably be allowed that it is extremely unlikely that ships carrying nine-inch guns, or guns equivalent to them, will ever be sent to attack a modern fortified place; and it may be assumed that the least gun which will be employed will be equivalent to the ten-inch 18-ton gun, and will require 18-ton guns to be opposed to it.

In this case, assuming that the Moncrieff system can be successfully applied to guns of 18 tons weight; in the absence of exact estimates, it may fairly be considered that the weight and cost of Major Moncrieff's carriage will be increased in proportion to the weight of the gun, that is, by 50 per cent. for a ten-inch as compared with a nine-inch gun carriage; the comparison will then be as follows, if the Moncrieff pit be assumed to be increased by 10 per cent. in cost., to receive a 10-inch gun.

	£
9″ gun-pit, with 10 per cent. added, say ..	1,180
9″ gun-carriage, with 50 per cent. added, say ..	2,010
Total for a ten-inch Moncrieff gun	£3,190

And—

	£
Open battery, &c., shield, with 15″ armour to resist twelve-inch guns, and overhead cover, say.	2,650
10″ casemate carriage and platform ..	490
Total for ten-inch gun behind shield ..	£3,140

If, however, instead of thinking only of the first cost to be incurred in fortifying a position, we pay some little attention to the probable requirements of the immediate future, a far more important consideration arises as regards the economy of the two systems. For armaments must change, and guns, such as the nine-inch or ten-inch, which at one time were the heaviest which could be made, and are now sufficient to meet the vessels of the day, may, ere long, be found inadequate to the task required of them.

Vessels plated with thicker armour are constructed, and then heavier guns follow as a natural consequence, and must replace those already mounted on the works. The works themselves can generally be adapted to their new armament with but trifling expense, but new carriages must obviously be provided, and in any system of which the carriage forms the most expensive part, every change of armament must prove enormously costly.

It may be said that in such a case the old armament could be used elsewhere, and no doubt the guns could and would be applied to different purposes, naval or otherwise; but if Major Moncrieff's system were generally adopted for coast defence, there would be no scope for the employment of the carriages for the heavier natures of ordnance, except in the sea batteries for which they were originally intended. The number of sea batteries is limited and practically complete, and land defences do not require such heavy guns. The same shield will, however, without any alteration, allow any nature of gun from the seven-inch to the ten-inch to be worked behind it, and with slight alterations, will permit the use of eleven-inch, twelve-inch, or even heavier guns.

In considering economy, however, in such structures, as well as efficiency, it appears to me that too much stress has generally been laid upon reducing the cost of a single gun as much as possible; and that it would be a safer plan to ascertain first, what sum is required to give proper efficiency to a gun, and then to use as many, well protected, as could be obtained with the money available for the defence of a place, rather than to crowd in a large number upon a cheap, imperfect system. Such would require large garrisons, of necessarily untrained men, would present more liability to the danger of being overcome piecemeal, and would afford more useful material to an enemy in the event of being taken.

The Moncrieff system is as much in its infancy now, as iron plates were ten years ago, when the cost of protecting a gun with iron, against the artillery of the day, was from £300 to £500; but the improvements in artillery have increased the weight of shot ten-fold, and the cost of protection fully four-fold; and if the Moncrieff system, or any analogous one were largely adopted, so as to make it worth while to devote special attention to the means of attacking it, there is, I think, no doubt, but that the cost of protection required would as largely increase.

The development of curved fire, which would appear to be the most likely method of attack, would surely not be such a difficult task as the development of armour piercing projectiles.

It is almost certain that no material improvements will be made in the shape and material of the latter; and it appears probable that the limits of weight and velocity are already nearly reached, on account of the difficulty of finding any material to withstand the strains produced on the inner tubes of heavy guns by the enormous charges even now found requisite.

We may, therefore, venture to hope that comparatively little if any further expenditure will be necessary to maintain the present invulnerability of our iron coast defences.

With earth or concrete parapets, however, the case is far different, and it is impossible, at present, to assign a practical limit to the dimensions and to the accuracy of fire of heavy shells, or to the destructive effects of the explosives they may carry.

A comparison of the two methods of defence will, I think, show that the best chance of success, in the example of a fortified position which I have selected, is offered by the use of guns properly protected by casemates.

This example might, if time permitted, be indefinitely varied; but, whether for a strong position attacked by an enemy's fleet, or for a small commercial harbour defended by a single battery; if the cases be worked out in detail, it will be found that the same considerations apply: that the value of torpedoes is to oblige ships to take up a certain definite position where they will be exposed to the fire of heavy guns: that, therefore, the training of the guns may be limited: and that the offensive power of a fleet consists in a shower of projectiles and fragments of projectiles of all shapes and sizes, and coming from all directions, from which overhead as well as front cover is absolutely essential.

The tendency at sea, with considerably more actual experience than on shore, has been to increase the weight, to diminish the number, and to increase the protection, both overhead and direct, of guns on board ship, and though the details are different, the general conditions are the same; and whatever system is adopted for ships must, to a great extent, regulate the means required successfully to oppose them.

I entirely fail to see, that, in fortifying a position such as that described, or any other which I can conceive, there is anything in Major Moncrieff's invention which is likely to overturn the recognized principles of fortification. The works necessary to receive a gun mounted on a Moncrieff carriage do not appear to differ, in any material respect, from those required for any ordinary gun mounted *en barbette;* and the magazine arrangements, and all accessories, must surely remain the same. The positions of works must be regulated by the effective range of the guns employed, and in what respect the fact of their recoiling under cover for loading can affect their range or accuracy is hard to be understood; whilst Major Moncrieff's favourite system of single gun-pits, spread out along a line of coast would, I think, develop, in practice, into something very much like the familiar old Martello towers, possibly somewhat increased in dimensions.

In, conclusion, it would appear that many arguments can be advanced, on both sides of the question, and the object of this paper is

simply to show that there is a great deal to be said on a side which is not generally heard; but the subject is, I think, of such a complicated nature, that comparisons, by words and arguments, will always remain unsatisfactory.

Persons taking one side will lay great stress on, and form their opinions from, matters which appear trivial to those who hold a different view; it is much to be hoped that the direct experiments, shortly to be undertaken, will solve some of the doubtful points indicated.

Even if it be impossible to rehearse exactly what may be expected to occur in an action, yet many points can be cleared up, such as to determine the angle at which shells will enter concrete at various velocities, to see the damage likely to be caused by splinters to a piece of machinery, such as one of Major Moncrieff's carriages; and to ascertain many other facts which have a most important bearing upon the general question.

Such crucial trials were made, upon experimental gun-shields and casemates, before those now defending our naval dockyards were constructed, and if the Moncrieff carriage passes as well through a similar ordeal, I, for one, shall be much surprised.

Table I.—Of the Chances against striking a Vertical Target, size 3′ 7″ × 5′ 0″ at various ranges, from a steady platform.

Range, in yards.	Gun.	Charge. lbs.	Projectile.	Angle of Elevation.	Angle of Descent.	Number of rounds fired.	Mean difference of Range in yards.	Mean difference of Deflection in yards.	Chances against striking.
1037	8″ howitzer	2	Common shell	40° 18′	43° 6′	3	14·	6·	388· to 1
1563	Do.	3	Do.	40° 12′	44° 25′	3	18·	5·	451· to 1
1750	10″ gun	60 R. L. G.	Palliser	3° 0′	3° 36′	20	20·8	1·05	6·3 to 1
1789	9″ gun	43 R. L. G.	Do.	3° 10′	3° 54′	10	81·1	4·4	103· to 1
2490	10″ gun	60 R. L. G.	Do.	4° 42′	5° 24′	5	16·	1·5	10·7 to 1
2633	9″ gun	43 R. L. G.	Do.	5° 7′	6° 54′	8	79·6	5·6	261· to 1
2658	11″ gun	85 P.	Do.	5° 11′	5° 50′	10	21·2	2·4	24·9 to 1
2671	8″ howitzer	5	Common shell	40° 8′	47° 20′	10	34·	6·	932· to 1
4283	Do.	8	Do.	40° 5′	51° 38′	18	45·	10·4	3068· to 1
4676	Do.	10	Do.	40′ 4	53° 6′	20	63·	18·	7816· to 1

Table II.—Of the Chances against striking a Vertical Target, size 3′ 7″ × 5′ 0″ at various ranges, with a mean error of elevation of $\pm \frac{1}{4}^\circ$.

Range, in yards.	Gun.	Charge. lbs.	Projectile.	Angle of Elevation.	Angle of Descent.	Number of rounds fired.	Mean difference of Range in yards.	Mean difference of Deflection in yards.	Chances against striking.
1037	8″ howitzer	2	Common shell	40° 18′	43° 6′	3	17·3	6·	480· to 1
1563	Do.	3	Do.	40° 12′	44° 25′	3	23·1	5·	585· to 1
1750	10″ gun	60 R. L. G.	Palliser	3° 0′	3° 36′	20	145·8	1·05	48·3 to 1
1789	9″ gun	43 R. L. G.	Do.	3° 10′	3° 54′	10	196·5	4·4	252· to 1
2490	10″ gun	60 R. L. G.	Do.	4° 42′	5° 24′	5	131·4	1·5	94·7 to 1
2633	9″ gun	43 R. L. G.	Do.	5° 7′	6° 54′	8	173·3	5·6	589· to 1
2658	11″ gun	85 P.	Do.	5° 11′	5° 50′	10	136·6	2·4	165· to 1
2671	8″ howitzer	5	Common shell	40° 8′	47° 20′	10	42·8	6·	1198· to 1
4283	Do.	8	Do.	40° 5′	51° '38	18	59·	10·4	3900· to 1
4676	Do.	10	Do.	40° 4′	53° 6′	20	79·	18·	9730· to 1

TABLE III.—Of the Chances against striking a Horizontal Target, size 27′ × 27′ at various ranges from a steady platform.

Range, in yards.	Gun.	Charge. lbs.	Projectile.	Angle of Elevation.	Angle of Descent.	Number of rounds fired.	Mean difference of Range in yards.	Mean difference of Deflection in yards.	Chances against striking.
1037	8″ howitzer	2	Common shell	40° 18′	43° 6′	3	14·	6·	10· to 1
1563	Do.	3	Do.	40° 12′	44° 25′	3	18·	5·	11· to 1
1750	10″ gun	60 R. L. G.	Palliser	3° 0′	3° 36′	20	20·8	1·05	6·3 to 1
1789	9″ gun	43 R. L. G.	Do.	3° 10′	3° 54′	10	81·8	4·4	45· to 1
2490	10″ gun	60 R. L. G.	Do.	4° 42′	5° 24′	5	16·	1·5	4·7 to 1
2633	9″ gun	43 R. L. G.	Do.	5° 7′	6° 54′	8	79·6	5·6	46·5 to 1
2658	11″ gun	85 P.	Do.	5° 11′	5° 50′	10	21·2	2·4	7·6 to 1
2671	8″ howitzer	5	Common shell	40° 8′	47° 20′	10	34·	6·	25·6 to 1
4283	Do.	8	Do.	40° 5′	51° 38′	18	45·	10·4	57·7 to 1
4676	Do.	10	Do.	40° 4′	53° 6′	20	63·	18·	139· to 1

TABLE IV.—Of the Chances against striking a Horizontal Target, size 27′ × 27′ at various ranges with a mean error of elevation of $\pm \frac{1}{4}°$.

Range, in yards.	Gun.	Charge. lbs.	Projectile.	Angle of Elevation.	Angle of Descent.	Number of rounds fired.	Mean difference of Range in yards.	Mean difference of Deflection in yards.	Chances against striking.
1037	8″ howitzer	2	Common shell	40° 18′	43° 6′	3	17·3	6	12·6 to 1
1563	Do.	3	Do.	40° 12′	44° 25′	3	23·1	5	14·5 to 1
1750	10″ gun	60 R. L. G.	Palliser	3° 0′	3° 36′	20	145·8	1·05	50· to 1
1789	9″ gun	43 R. L. G.	Do.	3° 10′	3° 54′	10	196·5	4·4	116· to 1
2490	10″ gun	60 R. L. G.	Do.	4° 42′	5° 24′	5	131·4	1·5	46·5 to 1
2633	9″ gun	43 R. L. G.	Do.	5° 7′	6° 54′	8	173·3	5·6	123· to 1
2658	11″ gun	85 P.	Do.	5′ 11°	5° 50′	10	136·6	2·4	54·3 to 1
2671	8″ howitzer	5	Common shell	40° 8′	47° 20′	10	42·8	6	32·5 to 1
4283	Do.	8	Do.	40° 5′	51° 38′	18	59	10·4	75·6 to 1
4676	Do.	10	Do.	40° 4′	53° 6°	20	79	18	174· to 1

The Chairman: Has any gentleman any observations to make on the paper we have heard? I should like to ask a question about your tables, Nos. I and II. Is II the limit to I? You have got the 8-inch howitzer, 1,037 yards in both, and the chances against striking in the one case which are constant, is 388 to 1, and in the other, 480 to 1. Is that supposed to be the limit, the maximum and minimum?

Lieutenant English: No. I Table is firing from a steady platform where the elevation is exact. No. II is firing as they might do at sea with an error of elevation of a quarter of a degree.

The Chairman: How is that got?

Lieutenant English: It is assumed as the amount of error of elevation, but the mean difference of range can be directly calculated from it.

Captain Goodenough, R.N.: Is the number of rounds from actual experiment from which those figures are deduced?

Lieutenant English: The whole thing is from actual experiment with the exception of the last column, and that is calculated from the official book, Captain Noble's Second Report on Ballistic Experiments. The formula for the calculation will be found at page 174.

Vice-Admiral Sir F. Nicolson, Bart.: You have assumed that the motion of the ship only gives an elevation of a quarter of a degree.

Lieutenant English: I have assumed it from the only experiment which has been carried on, bearing on the subject, the attack of the "Hotspur" on the "Glatton," where the mean difference I do not think could be taken as less than 3 feet at 200 yards, which corresponds almost exactly to a quarter of a degree. (Sir F. Nicolson: The mean error?) The mean error.

Commander W. Dawson, R.N.: As a naval man, I would venture to observe that Lieutenant English has fallen into an error as to the cause of that inaccuracy of fire witnessed whilst firing seven shot from the "Hotspur" at the "Glatton." I speak of this irregularity of flight not after the event, but as an incident of imperfect rotation and deficient centring previously known to artillerists. I happened to have a conversation with a Royal Artillery Officer of high rank and great experience, before the practice took place, who told me what his Shoeburyness experience taught him to expect from 600lbs. shot fired at ranges of 200 to 400 yards, viz., that they would rotate so imperfectly as to strike as much as two feet from the bull's eye, above, below, right or left of it. The seven shot fired at Portland did what this superior artillery officer foretold as likely to occur, even had the platform been on *terra firma*. Every naval gunner knows that a small roll of one or two degrees has no injurious effect upon the accuracy of aim, but, if it be a uniform motion, rather facilitates the process of aiming. If the firing were being conducted in the open sea with heavy rolling motion, instead of in a river or close to the harbour, I quite agree with the lecturer that the question of a degree of elevation is likely to be a small error for naval gunners to make, especially as the sights are very badly placed, and at present seamen are very badly trained as to eye exercise.

To pass to the general question, I confess I am a great deal reassured by what has fallen from Lieutenant English to night,—reassured, because, if I understand him aright, the Moncrieff system is not likely to be generally adopted. I say I am reassured on that ground because I confess that I did feel, as a naval man, rather reluctant that Major Moncrieff's system should succeed; and for this reason, that if our navy performs its duty to this country, no gun mounted on a battery on our shores could ever have an opportunity of firing at an enemy. But it would necessarily follow if Moncrieff's system succeeds in this country, that foreigners would employ it to defend their shores against British ships; and naval men have to judge how they would like to be opposed by guns popped up from holes in the ground which offered our seamen no target to aim at. This absence of visibility in a battery, comes home much more forcibly to naval men than to our military brethren. Military men are aware that there is at Gibraltar a battery called the "Snake in the grass," but perhaps they have not had the opportunities of studying that battery from a distance which are accorded to naval men. I am quite sure any naval man who has studied the batteries at Gibraltar, from the deck of his ship, would say that the battery he would least like to have to deal with offensively, is that very "Snake in the grass." A similar battery was pointed out to me the other day at Portland, on the side of

the hill which offers in the same way hardly any target at which naval gunners could take aim. Looking at that battery and at the one at Gibraltar, it has always struck me that the least formidable work to ships is a casemate, and the most formidable is that in which a gun comes up from a pit, and pops at you and then disappears, leaving no visible covering works to be destroyed. Having said so much as to the general principle of visibility and invisibility of batteries, I think the particular mode by which this invisibility is to be obtained and its cost in mechanical and engineering difficulties, is open to consideration. When I saw the 9-inch gun on Moncrieff's carriage fired at Shoeburyness last year, the machinery appeared to me rather more complicated and delicate than I had anticipated; and two questions arose in my mind, questions which I hope some military gentleman will answer, for I have heard them asked by various people. One question was this: Supposing the navy neglects to do its duty in blockading foes in their own harbours, and that a hostile fleet attacks our shores, and supposing that this disaster takes place fifty years hence, in what state would that gun carriage and its machinery be at outlying batteries say 20 miles to the westward of Pembroke, out of sight and out of mind—in what state would it be fifty years hence, to receive an enemy? The second question was, supposing a shot struck the crest of the parapet, and some stone, brick, or other material was thrown down amongst the machinery whilst the gun was in the act of recoiling on firing, would the machinery be seriously damaged and rendered incapable of further use? Those are the only two difficulties that strike me with reference to the mechanical part of the subject. I confess, when I come here to-night, and see by the diagram that Moncrieff's gun carriage is to be employed in an open battery with an elevated parapet instead of in a pit, it alters my argument in some degree. Still I can quite imagine that if an addition was made of a grass slope in front of the battery, with sunken defences and a grass bank or rising ground behind the gun a little way back, that the battery and its gun could be made utterly invisible to seamen gunners, I should certainly dislike, very much indeed, to have such an invisible battery armed with such hidden guns opposite to my ship; whereas guns placed in a casemate are respectable objects to hit, for there is something tangible to see, and something which if British guns are worth anything, and have not "decidedly the lowest velocities" and worst penetration, they will be very likely to pass through and destroy. As to the gun-shield, I confess I am ignorant of its constructive details as well as of its appearance when in position. There is no diagram of such a battery before us, and in the absence of such information I am unable to form any opinion as to its relative merits in comparison with the casemate and with the gun-pit, from a naval point of view.

Major Moncrieff, F.R.S.: Mr. Chairman and Gentlemen, I hope that this meeting does not expect that I should without notice meet the arguments, and go into all the details of the tabular statements that have been brought forward to-night. Until I came here I did not know what form this lecture was to assume, and I must say that I have been somewhat surprised at the tenor of Lieutenant English's observations. I know his position as an Officer of the Works Department, and I presume the case he has brought forward, represents to a certain extent the views of that department. I am also now made aware, from the statements of Mr. English, that these views are adverse to mine. The essence of his remarks may be recognised in this sentence:— "I entirely fail to see that there is anything in Major Moncrieff's invention which is "likely to overturn the recognised principles of fortification." "The works neces-"sary to receive a gun mounted on a Moncrieff carriage do not appear to differ in "any material respect from those required for any ordinary gun mounted *en bar-"bette*, and the magazine arrangements and all accessories must surely remain the "same." If that is the view of Mr. English and of the Works Department on the Moncrieff system, it is evidently quite different from mine. I believe that the system is capable of introducing very important changes in fortification, not only in that part to which Mr. English has confined his observations bearing on coast defence and in relation to heavy guns, but in many other developments. The question of coast defence does not only consist in the application of iron-punching guns, but also in the dispositions for meeting the landing parties which fleets could dispose of. No ordinary batteries could withstand the fire of the heavy artillery of ships without being completely silenced, and I am not aware that any plan but mine has been yet

advanced for meeting this contingency, except the expensive iron works with which Mr. English has been so much concerned. There are many places on the coast, including the neighbourhood of batteries of the first class, which, while exposed to ship's artillery, must also be defended against land attack, for instance, the flanks and rear of important batteries, the gorges of which in existing batteries are not particularly strong in some cases. That is a part of coast defence altogether independent of very heavy land guns. I object now, however, to take up this question, and argue each point *seriatim* with Lieutenant English, because I am not a speaker, and I cannot thus convey my ideas at a disadvantage. All I have to say is, that there are many statements advanced in this paper, which I can meet and refute. I would prefer an opportunity of doing so in a form that would be more satisfactory to the meeting. A question was asked by Captain Dawson about the state in which one of my gun-carriages would be fifty years hence in comparison with another gun-carriage. That is a question which I am able to answer. I believe that any practical engineer who examines my gun-carriages would see that they have as good, if not a better chance, of being in fit condition fifty years hence as any other gun-carriages, and for this reason, that they do not depend upon any nice adjustment or gearing for their proper action. I allow that they appear to be complicated, the more so from their novelty; but that complicated appearance is given by the gearing required for lowering the gun, and for drill purposes. Those parts of the carriage which are required for fighting purposes are very simple and not likely to get out of order, and I should say the carriages will compare very favourably indeed in this respect with others used for guns of the same calibre. I would also like to protest against assumptions by Lieutenant English, that because my system has as yet only been carried as far as a 12-ton gun, that it cannot, therefore, be carried further than an 18-ton gun. I take this opportunity of publicly stating that, when the time arrives for doing so, I am prepared to mount the very heaviest artillery that can be produced. I shall be ready, when that time arrives, to mount 50- or 100-ton guns if necessary. It is not my fault that so little progress has been made, and I object to that delay being used as an argument against further progress. I would remark that I am kept in ignorance of the way in which the Works Department intend to apply my system. I have not been consulted in the manner which I had expected regarding the Moncrieff works; but, on the other hand, I see clearly from the exposition that we have had to-night, that the Works Department, judging by that exposition, do not know what my system is capable of, nor correctly estimate its importance. I think it would be better if we both knew a little more of each other's views regarding these matters; it would be better for me, and it would be better for the public service. Had such been done, probably some of the statements which are embodied in this paper would not have been publicly brought forward.

Captain BURGESS: I should like to know whether any experiment has been made to show how many shot and shell would fall into a gun-pit from a 9-inch gun at a certain range?

The CHAIRMAN: Those tables are meant to meet that.

Captain SELWYN: Are your tables made from actual experiment, or from assumption?

Lieutenant ENGLISH: Except the last column, as I have already stated, they are the result of actual experiment.

Captain SELWYN: I have been waiting to hear some one on the military side of the question; but as the Lecturer has principally given us an exposition of presumed attack by seamen on batteries, I think seamen may very fairly have a very large word to say, and I start by saying, that any seaman of the present day who attempted to attack in the manner shown by the Lecturer probably ought to be tried by a court-martial and dismissed the Service. In the first place, there are natural advantages for a fleet as to position which are not in themselves to be ignored, but I say distinctly, as I have said once or twice before, that no attack by fleets is ever to be expected round our island at points which are carefully fortified. The great art is to spread your defences as much as possible, and not to let your enemy know where they are. Unfortunately, the publicity which is given to everything renders it nearly impossible to fulfil the last condition, but luckily the newspaper eyes,

although almost ubiquitous, are not quite so, and occasionally a nice little battery on our coasts gets neglected, which would receive an enemy very unpleasantly if he came near it. That battery will be infinitely more formidable, notwithstanding all that the advocates of casemates may say, in proportion as it covers a larger area of fire. It is no use to tell me that when you get up against a battery you would be affected by a very heavy fire. If I can find one single spot on the whole water horizon where I can place a ship and she cannot be struck by a gun in the battery, that is precisely the place I will go to. If you will give me nice little islands, I will put gun-boats behind those islands, not carrying 9-inch howitzers or contrivances of that sort, but carrying the very heaviest gun that can be put afloat. There is no difficulty; people have said there was, or supposed that there was; but no man that knows anything of the sea, thinks that there is any difficulty in carrying heavy guns in a gunboat. We carry 18-ton guns now, and we will carry 30- or 40-ton guns. But there has been a manifest reluctance to give to the Navy anything like what they would like to have, either in the way of attack or defence; we are always supposed to attack where we would not go; we are always required to defend with guns that we do not approve of. As long as that is the view that artillerists on shore take, we are at a disadvantage, but I trust the expedients in which seamen have generally shown themselves fertile, will still enable them, when they have to attack a foreign enemy, to nullify those disadvantages. As for torpedoes they are an enemy which hitherto, with our present construction of ships, we have not seen any way of avoiding; but we know perfectly well, with steam at our command and by the sacrifice of smaller vessels, we can sweep a channel clear of torpedoes. At night we can cut off, without much difficulty, all your communications with your torpedoes through electric wires, and you shall never know that we are doing it except by the disconnection with your galvanic battery. All these things are details which will be carried out by seamen when the necessity for them arrives. But when we are asked to believe that something we cannot see, spread out like a table-cloth on the ground, at any range between 500 yards and 3,000, is a better mark to aim at, and that we have more chances of hitting it, than a target made up of a casemate,—for all the casemates we have yet built are made on the assumption that the gun-power would not go any further, that there would be no advance in guns, or that granite would continue to resist, in exactly the same proportion, if you double the thickness of armour in the casemate; that accuracy of fire would not be increased, and that we should always aim at ports,—we doubt the justice of the conclusion. Now I think Lieutenant English, by his own table, has shown that the maddest thing on earth would be to try to fire at gun-boats. I should be very glad indeed to find an enemy in a battery with a bright idea that he would hit a man in a port. If he fired at the port, the chances are he would never hit the ship. His error would be quite sufficient to carry him quite clear of the gun, I am quite certain, and probably he would never hit the very vulnerable portion which is the part we do fear for in modern ironclads, namely, the deck. Our vulnerable part in ironclads is shown when we advance end-on, and a length of some 600 feet is exposed as a deck to curved fire, for that shot which strikes us somewhere near the forecastle goes out through the stern, and very probably takes off the rudder. That is where our danger lies, and we do not intend to encounter it if we know how to guard against it, but when I am asked to believe, first of all, that that is a fair representation of a Moncrieff gun-pit, I utterly deny it. The whole value of the Moncrieff battery is its invisibility, but if you are to show me something on a bank like *that*, (referring to the drawing of a raised (Moncrieff) battery,) which I can see for many miles, I shall probably fire at that, and not at the puff of smoke. I have seen a good deal of firing at puffs of smoke, and my remembrance is, that they were always fired at when they were some 200 or 300 yards to leeward of the gun that fired. The artilleryman saw the puff of smoke, but he did not exactly calculate where it came from, and he fired at what he could see. It is a most unsatisfactory way of firing. If you can put gun-boats at long ranges and a battery is firing at them, I am quite certain you will spend every shot in the battery before you will demolish five guns. The chances are 1,000 to 1 against your hitting. I suppose I may say after that table, 7,816 to 1, at the long range. Well, now, I ask you, is it reasonable to suppose that anybody will throw away shot from a battery

to try to hit a gunboat which everytime will hit you. Your battery is much bigger than the gunboat; your battery is very visible, but the gunboat, if behind one of these islands, is not visible at all. And more than that, you do not know when you have hit. If I was taking that river, as it is shown there, there is, I think, fully one-third of the water shown there on which not one single gun can bear—on which any person could hit a vessel. That is where I should place my gunboats, behind those islands. (Lieutenant English: Those islands are simply shoals of less than 18 feet deep at low water.) They look like islands—shoals and islands, such as would occur in any channel we are acquainted with. (Colonel Jervois: You cannot hide yourself behind shoals.) It depends on the tide. If I knew there were shoals at low water, I should go there at low water, and I should go away at high. But you must recollect that in this whole question we are asked to believe that a battery set up to be fired at on the shore, with casemates and granite, is less vulnerable than earth of unknown thickness, and where there is no target whatever to aim at. If you take a Moncrieff gun-pit and transform it into an elevated battery, and then heap earth round that battery, and call that a Moncrieff gun-pit, I should quite agree, first, that you have not understood the Moncrieff system at all, and secondly, that you have made a very easily attackable battery. But that, I presume, is what no talented engineer would do. Now take the question of attack. I ask you to believe that this point is the only one which we can attack, and that I want to attack that with a fleet, as all fleets do now, carrying troops. I do not think anybody in his senses would proceed in any other way than that in which armies proceed when they are passing a defile. You would crown the heights, you would land and carry the batteries in reverse, protected by the fire of the fleets; and if they are casemated batteries, like that, they are much more easily attacked than the Moncrieff gun-pit, which can traverse its guns round to fire on attacking parties on the land side. These casemate batteries cannot do that. Is it or is it not an advantage to have a turret on board a ship with a theoretical all-round fire? and if so, why should it be a disadvantage to have a practical all-round fire on shore? Again, compare the expense. It is assumed that no foundations will do other than those which suffice to support the weight of a great granite battery with casemated shields of unknown thickness, for we have not yet arrived at the thickness which will protect guns; we are asked to believe that these same foundations will be necessary to support the weight of single guns, or numerous guns, if you like to put them in a battery. I cannot conceive it—I cannot understand it in any sort of way. I know in the attack of Charleston it was found sufficient to lay down on a positive swamp a certain amount of fascines with baulks of timber over them, and that on an improvised platform a heavy gun was fought for months with good effect. I say mud is a better sustaining power than water, and that what we can do on water, the weight we can support on water we can certainly support better on mud, and there is no difficulty about doing that without trying to pile down to the bottom, and then to erect a concrete foundation afterwards, which in some cases in our modern batteries has split in two, because it has no solid foundation. That is not engineering. I do not think any such assumptions are of any value in this Institution, they are nothing but assumptions from beginning to end. There is the assumption that there was a swell at the Needles: we will admit that the error was due to the swell, though it is a very curious swell which cannot be detected by a gunner who is pointing his gun. He must know it perfectly well; and if he cannot shoot straight he has not learned the ordinary training of the eye on a man-of-war, which allows for much larger changes than that. We will admit that it was due to the swell, but is that a fair measure of what will occur in a river? Will any man tell me that gun-boats or ironclads coming up the Thames would be subject to the same swell as at the Needles, or that that is a fair thing to take as a basis of assumption for the chances of striking. These are nothing but the broadest assumptions justified by the very slightest experiments. Ballistic experiments do not give you any measure of the error due to firing large guns and mortars with unknown atmospheric changes, with powder of varying densities. More than two or three years since we had a comparison, by Major Alderson, of the difficulties of hitting a horizontal plane, and, according to him, we might have fired all day and never could have landed one single shell in a Moncrieff battery. This was the state of the case

when accurate experiment was made at Shoeburyness. He would have had no difficulty in hitting a casemate every time at the same range. And if you come to carry Lieutenant English's own figures further you will see if this be true of the attack, still the defence has this disadvantage, that while a battery is a large-sized object, and perfectly visible, the gunboat is a very small-sized one, and is not only very imperfectly visible in consequence, but she is also capable of rapidly changing her position, so that a few turns of the screw, which no man at the battery could detect, would at once place the range at fault. I have seen at Gibraltar a detachment of well-practised artillerymen one whole day trying to hit a 12-foot target at 1,200 yards because the target was sweeping about a little in the tide, and they never struck it during the whole day. You imagine what the mobility of a gunboat is in preventing the extreme accuracy which has been calculated as *against* Major Moncrieff's gun-pits in one direction, but in favour of the casemated battery in the other. Then, again, I remark, with the greatest pleasure, that whereas four years ago, for the first time, you were told by Major Moncrieff that there was to be a system by which every harbour would be mapped out so accurately that parties at a considerable distance from the batteries themselves, communicating electrically with those batteries, should be able to direct their fire without being puzzled by the smoke, I am delighted to hear that at last, some of the authorities seem to be alive to the value of the suggestion. That is a modicum of advance. A still greater advance will be made, I have no doubt, when inventors are allowed to have some sort of idea of what is to be done with their own inventions, when they are allowed to give the time and attention which the nation has already paid for to the subject, instead of engaging men who have never shown the slightest power of appreciation of their inventions to do exactly what the inventor told them they ought not to do. This is a very lamentable state of things, and I have no doubt as long as it lasts every invention that can possibly be applied will be shown to be utterly impracticable and totally wrong. The inventor says, "Well, you have given this account, but I am afraid I cannot endorse it at all. I shall be very glad if you will allow me to tell you what I do indorse, and to relieve you from the burdens which you seem to be labouring under;" and I am quite sure from what I have had the pleasure of knowing of Major Moncrieff, that he is, of all other men, the one most ready to give information if asked for, and the most reluctant to force it on where he finds that it is coldly received.

Captain DAWSON: I think Captain Selwyn would like to be corrected as to the question of the "Hotspur's" firing. It was inside the harbour of Portland, and the roll was so exceedingly small, that a brother gunnery Officer reminds me, even if it had been three or four degrees instead of being less than one degree, it would have had no appreciable effect whatever upon the accuracy of the fire.

Major MONCRIEFF: I should like to add one remark. The Lecturer dwelt upon the horizontal exposure of my emplacements, and estimated that exposure at 27 feet square. That is a considerable area; the actual opening is about 20 feet in diameter. I would wish to remind the meeting that my batteries are not the only open batteries. The shield batteries are also open. In Lieutenant English's paper he takes for granted that the shield batteries are covered. It is very true in one sense that they are to be covered. Balks of timber covered with earth and with 6 or 8 feet of concrete in front above the shield, but that cover is not capable of resisting such projectiles as would be delivered against these emplacements by ships of war. Possibly cover of this description instead of being a protection in action would be a source of danger, both with direct and curved fire from heavy guns. At any rate, when so much curved fire has been directed against my pits, I think a little notice should be taken of the exposed horizontal area of shield emplacements. There is no plan exhibited here of a shield emplacement, but if you will examine such plans, I think you will find that, excepting a splinter-proof cover, the horizontal area exposed to the penetration of heavy shot and shell is quite as large, if not larger, than that of the Moncrieff pit.

Colonel JERVOIS, R.E.: I rise to make only one or two short remarks. With reference to Major Moncrieff's supposition, that Lieutenant English is necessarily giving the views of the department to which he belongs, I must observe that that is not the case. Some people belonging to that department may hold those views;

others may not. Lieutenant English comes here in his private capacity, as an Officer representing his own views. I venture, however, to submit that those views deserve full consideration.

The Chairman: I, for one, shall be very glad to give them consideration. Of course any Officer who speaks in this Institution is not supposed to be giving the opinions of any other people, but his own.

Colonel Jervois: I will add—speaking for myself as an individual—that it cannot be supposed that I am opposed to Major Moncrieff's mode of mounting guns; on the contrary I am one who desires to give it the fullest play possible. I have no stronger testimony on this point than that of Major Moncrieff, who, in the most handsome manner, volunteered on a certain occasion to write to the "Times," to say that it was to your humble servant that the introduction of the carriage into the service of this country was mainly due.

Lieutenant English: Unless Colonel Jervois had spoken I was prepared to state that of course my views were my own only, and in my own private capacity, and that I did not consider any person hearing me would imagine otherwise. With that preliminary I will meet one or two of the objections to my paper.

Major Moncrieff says his carriage would be as good as any other in fifty years. I have not entered into any of the mechanical questions connected with the carriage, and would rather not give any opinion upon it at all. But I would like to state that I have made no assumption whatever that his system cannot be carried further than the 18-ton gun. For myself, I believe it can be carried to any weight of gun, but that the cost will increase enormously in doing so. I have attempted to show in my paper that with an 18-ton gun, the cost of a gun mounted on the Moncrieff system is more than that of a gun mounted behind a shield, and if the weight gets greater, the discrepancy in cost becomes greater also.

With regard to Captain Selwyn's remarks on these diagrams, that a position like this would not be attacked in that way, because a fleet would not attack points that were carefully fortified, it seems to me if a fleet is to pass through a channel it must pass up the whole length of it, and therefore pass points that are carefully fortified, otherwise it would not fulfil the object set before it. I do not propose to give any opinion on the merits of the 8-inch howitzer; certainly its firing seems to be tolerably good, and it seems to me that if the deck of an ironclad is the most exposed part of it, surely the surface of an open battery is in a very similar situation; and unless earth is "heaped up to form a battery," there is no way of seeing the enemy, and nothing much to prevent a party landing at night and doing what they like with the guns.

Major Alderson's remark on landing shells in the Moncrieff pit was noticed. He was said to have had no difficulty in dropping shells on to a casemate, but very great in dropping—— (Captain Selwyn: Striking.) I understood it was dropping shells into a Moncrieff pit; but that firing, it must be remembered, was with the 13-inch mortar, and these calculations are taken with the 8-inch howitzer. The accuracy of the two is rather different.

With regard to the point Major Moncrieff raised, that an open battery would not be able to resist curved fire, it seems to me if you can put any protection at all against curved fire, there is no difficulty in increasing it as much as may be thought desirable.

The Chairman: I do not think a more important subject can be brought before us than that discussed to-night, and it is one, the discussion of which we ought to enter into dispassionately, and without professional jealousy or prejudice. There are enormous difficulties in the way of working the guns of the present day. A few years ago they were of moderate size and range, and simple mechanical means, such as the lever, the pulley, and the inclined plane, in the shape of the elevating screw, did everything we wanted, worked by the men themselves; we now require much more elaborate machinery, and a greater power than the mere sinews and muscles of the gunners to work it. We must, therefore, have patience with those who are thinking out this great question; Major Moncrieff is one of them. These matters require grave consideration, and conclusions can only be arrived at by careful practice and experiment. I am sure the meeting will join me in thanking the Lecturer for his very interesting paper.

Evening Meeting.

Monday, 9th June, 1873.

Colonel the Right Hon. Lord WAVENEY, F.R.S., A.D.C. to the Queen, in the Chair.

NAMES of MEMBERS who joined the Institution between the 20th May and the 9th June, 1873.

LIFE.

Turner, N. O. S., C.B., Col. R.A.
Povah, J. R., Lieut. 1st Royal Scots Regiment.
Johnson, Allen B., Col. Bengal Staff Corps.

ANNUAL.

Goldsmid, Sir Frederic, C.B., K.C.S.I., Major-General.
Bailey, Henry, Lieut.-Col. Grand Trunk Railway Brigade, Canada.
Booth, J. Gore, Lieut. R.E.
Bevington, H. G., Capt. 1st London Artillery Volunteers.
Jopp, Keith, Lieut.-Col. Bombay Staff Corps.
Alexander, Hon. Charles, Lieut. Royal Tyrone Fusiliers.
Aldworth, Robert, Capt. North Cork Rifles.
Marquis, Jas., Col. 17th Bengal Native Infantry.
Toke, John, Major 1st Berkshire Rifle Volunteers.
Bower, J., Lieut.-Col. Hants Mounted Rifle Volunteers.
Turnbull, J. F., Maj. Canadian Hussars.
Gautier, F. E., Capt. Canadian Navy.
Montizambert, C. E., Maj. Canadian Artillery.
McDonough, S., Maj. late 3rd W. I. Regiment.
Harrington, S. C., Esq., Purveyor.

FURTHER OBSERVATIONS ON THE MONCRIEFF SYSTEM OF MOUNTING ORDNANCE.

By Major Moncrieff, F.R.S.

I feel bound to make the remarks which I have now the honour to address to you, in order to supplement the "Observations on the Moncrieff System," which Lieutenant English read here on the 31st March; the case as left by him not being, in my opinion, quite complete.

An answer to such observations is not easily extemporized. My time is much engaged. I therefore felt reluctance in undertaking the task of making further remarks on this subject *apropos* to such "observations." I know also that what is done reluctantly is seldom done well.

Lieutenant English presented you with a paper very carefully elaborated, and showing much ability, although I am not quite able to agree with all his arguments, or even with the premises on which some of

these arguments are based. My wish is to explain to this meeting that there are views relating to the Moncrieff system which can be held on good grounds, and which are somewhat different from those contained in that Officer's lecture, and my hope is, that I may be able to remove some unfavourable impressions which that lecture was calculated to produce.

Although Lieutenant English's paper was entitled "Observations on the Moncrieff System of Mounting Ordnance," it must have been apparent to those who understood the question, that the Lecturer was thinking more of iron shields and casemates (with which he has been so much identified) and of their advantages, than of the Moncrieff system, which was his text. I felt that it was due to those who would give credit for a certain amount of judicial impartiality to opinions coming from a young Officer of the Works Department, to point out another view of the case, and to give some means of testing the validity of the Lecturer's arguments.

The Lecturer was aware of the following facts :—

1. That the Moncrieff system had only been applied as far as a 9″ 12-ton gun.

2. That it had only been used for open batteries having certain horizontal exposure, and little or no vertical exposure.

3. That it was capable of giving increased lateral range.

4. That in coast defence it would mostly be attacked by ships' artillery. And

.5 That it was cheap.

Accordingly with his paper, he supplied four tables, in which the inferiority of the 9″ 12-ton gun is made to appear. These tables seem to be formed for the purpose of showing that horizontal exposure was nearly as dangerous as vertical exposure. A case of coast defence is selected as the illustration, in which lateral range is not of average importance, and of which there is only one specimen in this country. He assumed that no iron-coated batteries are open in any sense, while at the same time he assumed a horizontal exposure of 27 square feet in Moncrieff pits ; and he hinted that a cheap system must be a bad one.

I shall take up the argument in the order above stated, and first direct your attention to the tables that were exhibited at the lecture.

Such tables always have a formidable appearance, at least they have so to me. They speak with that statistical authority which is so much respected in the House of Commons, and by a people like ourselves, who are pre-eminently lovers of facts however ugly may be their garb. I confess to having a vague and indescribable respect for such columns of condensed labour and information. When the Chairman asked the Lecturer where he had obtained his tabular statistics, and received so satisfactory an answer as to their source, nothing more was to be said. Notwithstanding this, however, I was startled to see the averages and the practice from which they were struck. I could scarcely believe my eyes when I saw my old friend the 9″ 12-ton gun had been so much eclipsed by the new rifled howitzer, and by the 10″ and 11″ guns.

In Lieutenant English's tables I find that the 9″ gun has a mean error of 81·1 yards in range and a mean difference of deflection of

4·4 yards at a range of 1,789 yards, while, on the other hand, the 10″ gun at 2,490 yards, that is 721 yards further, has only a mean error of 16 yards in range, and a mean difference of deflection of 1·5 yards.

I had always supposed that the 9″ gun, for which I had provided a successful carriage, ranked in accuracy of shooting with the other pieces in the service, and for some time this disclosure of its inferiority on such good authority, weighed heavily on my spirits. To those of still greater faith than mine the statement must have appeared quite conclusive. A gun that shot so badly must have appeared to them to be indeed of little use. It is true that the gun is powerful enough to sink any light armoured vessel at 2,000 yards or more, and against unarmoured vessels it is as effective as more powerful guns; but if Lieutenant English's tables gave a fair comparison, it could not be expected to do much good, and a Moncrieff carriage might as well not have been designed for it.

As a good many of these guns are in the service, I am glad to inform you that Lieutenant English had overlooked the normal practice of the 9″ gun for his illustration, and had picked out the worst shooting recorded that he could find. The practice from which he selected for his tables related to an experiment for which the 9″ gun was employed, not to determine its shooting, but to observe the effect of firing shot with various forms of head, and with studs of different kinds made of amalgams of copper and tin, and even of soft iron. It was, moreover, noted at this practice that all the shots were noisy and unsteady in leaving the gun. I should also add that both the cases in the tables in which the 9″ gun is given, were taken from this practice. The shooting of the 9″ gun is not, therefore, to be correctly judged by the tables on which the Lecturer's case so largely rests. And I trust, therefore, that you will not allow your minds to be unduly influenced by the character of the figures these tables bring out.*

One would have supposed that an ordinary instance which would have given an average specimen of the shooting of the 9″ gun with nearly the same degree of accuracy as the 10″ gun would have been better suited for this purpose than a case where it was five times as bad in range and nearly three times in deflection. If this result does not prove that the 9″ gun should be put out of the service, Moncrieff carriage included, it shows at least that mistakes in judgment are sometimes made by being too anxious to make out a case. This accident of selection is doubly unfortunate, as, by Mr. English's system of calculating the chances against striking brought out in his tables, it is demonstrated that the 9″ gun has only got a chance in one case of 103 to 1, and in another of 261 to 1 against striking a vertical target, while its rivals in the table, viz., the 10″ gun and the 11″ gun, have chances against striking the same target the 10″ of 6·3 to 1, and 10·7 to 1, and the 11″ of 24·9 to 1; in other words the 10″ and 11″ guns are made 13 times better than the 9″ gun in their shooting. Let us look also for a moment at the results brought out by these tables in regard to the efficacy of fire delivered from ships.

* See Appendix, p. 609 (inserted at Major Moncrieff's request since the reading of his paper.—Ed.).

It was evidently desired by the Lecturer to reduce very much the apparent advantage of having only horizontal exposure, and to make light of the danger of having open ports exposed to horizontal fire, for no other reason, I suppose, than because Moncrieff batteries happen to have horizontal exposure, and, on the other hand, casemates and shields have vertical exposure and open ports. If this was the Lecturer's motive, the desired result is as completely obtained as the condemnation of the 9″ gun, but by another process. It is in this case effected in the tables by some omissions in the calculations of the chances. Simple expedients are generally the most successful. It is quite well known, and requires no tables to prove it, that a miscalculation of range which would only cause an error of inches against a vertical target, might give an error of yards in a horizontal one; and that the difficulty of ascertaining the exact range from a floating and moving battery, is considerable. This chance, however, is not allowed to affect the figures in the tables. Such an omission might have been more indulgently overlooked, had the comparison been confined to shields and casemates alone, which are visible and indeed clearly defined, and their range therefore not so difficult to determine; but when it is extended to a comparison with a species of battery, the principal characteristic of which is, that it gives little or no indication of its exact position, the omission is more difficult to account for, except on the hypothesis that the Lecturer was so desirous to make good his case and to reach his conclusions, that his faith removed on that evening the mountain that stood in his way.

There is another slight omission which one would scarcely have expected to find in a formal statement of the chances of hitting the port of a shield or casemate by direct fire, and considering that the exposure of an opening of 10 or 11 feet radius is shown at 27 feet square for the horizontal target, the vertical target might have had the chance of ricochet thrown in for the sake of appearance. Although this chance has been omitted in the tables, I can assure the meeting it is a chance well worth considering, especially with a shield emplacement, and I shall afterwards refer to it. I put my own interpretation on the character of these tables, and accept them as a high compliment to the new system, which evidently requires to be attacked by very curved fire indeed.

Some good practice with the 8″ howitzer is given in the tables at 40° elevation and 5 lbs. of powder at 2,671 yards range. It is quite certain that sailors are too knowing to attack casemates with so small a charge of powder. I therefore congratulate Lieutenant English on his favourite works being likely to escape from the precision of this admirable weapon. When these howitzers are worked on board ship it would be interesting to determine how much error would be caused at this high angle of 40° by rolling and miscalculation of range added to observed error, and how many times a few guns in Moncrieff emplacements would be likely to hit the ships before the ships could put a shell into the emplacements, firing at 40° elevation; but I would rather that Lieutenant English would not calculate those chances on his own method.

The same free treatment of the subject discovered in the tables, appears to prevail in the arguments.

I suffer a good deal of inconvenience, and my system gets very roughly handled sometimes by a method of attack which I have not yet learned how to meet. I have serious intentions of practising the "kriegsspiel" with the view of getting a hint as to the proper tactics for me to pursue in such cases.

To enlist the kind sympathies of my hearers, I must explain, that methods of applying Moncrieff batteries that I cannot defend, which I never contemplated, and which it would be impossible for me to accept as proper expositions of the new system, are, as occasion offers, imagined, and then under the name of the Moncrieff-system, attacked and demolished.

It is most difficult to know what course to take in these circumstances, so much explanation is necessary. A very common form is to suppose a Moncrieff battery in a position requiring flank defence, which has not been provided; it is then described as having no flank defence, and compared with another battery which has it; the superiority of the latter is thereby established.

A great part of Mr. English's paper is occupied by a detailed description of the attack and defence of a position similar to the Thames at Coalhouse Fort. I have no wish whatever to criticise the views advanced in this part of the paper. The case selected but slightly affects the majority of cases, and the nominal subject of the paper; it is only when it does so that I care to revert to it.

Referring to the arguments relating to foundations in the case selected for illustration, which is the Valley of the Thames with its low and marshy shores, may I be allowed to remark, that when lateral range is unnecessary, and it is at the same time required to put the greatest number of guns on the smallest possible front,—which is very rarely the case,—this can be done by the new system on a smaller front, and consequently on less extensive foundations, than with shields and casemates. Double the number of guns can actually be mounted on the same length of front by the new system. As a rule, however, this would not be done; and it might I think be safely stated by me that the foundations for a 10-gun battery would generally be nearly twice as extensive as those for a 5-gun battery and five times as extensive as those for a 2-gun battery. What, therefore, can the Lecturer mean by remarking as an argument for not using my system, that "the cost of "foundations is a necessary evil, not adding in the slightest degree to "the offensive power of a battery, should be kept down as much as "possible." It is true that it might occasionally be more expensive to break new ground; but efficiency is surely, in a case of this kind, quite as important as any other consideration.

In answer to the statement, that "it is quite impracticable to get over "this difficulty by planting guns in the mud without any foundations at "all," I would venture the remark, that some of the batteries in the London clay on the Medway and the Thames, have been constructed under very great engineering difficulties and at great expense, owing to the impossibility of providing reliable foundations for the weighty super-

structures which the old system requires; and further, that I will stake my reputation as an engineer on being able to establish my batteries in this mud, and form good barracks in the immediate neighbourhood, at a much smaller cost than the others could be constructed for, giving to each battery complete and formidable flank defence by the natural barriers in such ground, viz., wet ditches, &c. High gorges requiring foundations are surely better away if not absolutely required in these positions, in which, for humane reasons, that will be understood by those who have had the ague, the men had better not be permanently stationed except during the threat of war.

The Lecturer states that "the one advantage of extreme lateral "range is to provide against the rather improbable case of one, or of a "small number of vessels attacking a number of heavy batteries." This argument, or assertion, is familiar to me. I would ask, Is it a sound argument; is it a true assertion? and if true in the case selected by Lieutenant English, would it remain true in other cases?

I shall take Lieutenant English's case, as it is weak for me and advantageous for his view.

A narrow channel with flat shores has to be defended. I should suppose that the natural way of doing so, at least of doing so by my system, would be, first to select a favourable point for laying down marine and submarine obstacles, and then to plant the batteries so as to converge on these obstacles, and at the same time to bear down the channel.

If the batteries are composed of guns with small lateral range, such as those behind iron shields, to perform both operations, that is, to bear on the water near the obstacles, and also on the channel for a few miles below them, they must either be massed above these obstacles, or else divided into two classes, viz., those which bear on the obstacles, and those which bear on the channel.

These alternatives have nothing to do with the number of guns and the number of attacking vessels.

If the guns are massed in such batteries as Lieutenant English prefers, they are more easily bombarded, long range or incorrect fire is more likely to tell on them, and they might be more encumbered with their own smoke.

If they are not massed, only one portion of them can bear on the channel below the obstacles, and there is therefore a loss of power, or else an increased number of guns required.

If the front of attack is more extended, and the range of the guns still limited, the enemy would select that part of the sea during the attack for the positions of their ships on which the fewest guns bore; the remaining guns would thereby be *hors de combat*. Limited range of guns is therefore in this case also a waste of power on the part of the defence. I do not see how the Lecturer can get out of this dilemma without selecting some still more abnormal case than he has chosen, and even that would require some ingenuity.

This is so important a part of the whole question that I cannot allow it to be dismissed by such an assertion. Is it the case that "the one "advantage of extreme lateral range" is "to provide against the rather

"improbable case of one or a small number of vessels attacking a "number of heavy batteries?"

Lieutenant English, talking of the ships, remarks—"They would then "concentrate all their fire by signal with battering charges upon one "of the works furthest down the channel at ranges varying from 1,000 "to 2,500 yards." In such a case, might I ask, would or would it not be an advantage to be able to concentrate the fire of all the land guns on the ships, and might I also ask would it be a disadvantage to have batteries on which the battering charges he refers to, would be of no more use than small charges?

Would it be no advantage to have the guns so arranged that the silencing of a few of the batteries would not reduce the exposure of the ships in any one part of the position more than in another part?

Lieutenant English complains that arguments have been founded "on an ideal case of a duel between a single gun in a shore battery and "a single gun on board ship." This cannot, however, be brought against me, as I have never advocated single guns except in positions where single guns are most advantageous. His own hypothesis is, I would submit, equally incomplete, and much more improbable, viz., that if a position was to be attacked, the enemy would invariably station itself to be battered by each face of such shore batteries at once. If the enemy was aware that the lateral range of the guns was limited, so that the guns bearing on one part of the position could not, from being in casemates, bear on some other part, he would, it may be safely stated, prefer some part of the position in which all the casemates could not command him.

Assertions on such a subject, when they come from an Officer of a Department that receives much credit for correctness, have generally more weight than arguments, and they should, therefore, I submit, be carefully considered before they are uttered. I cannot help thinking that had the Lecturer considered his sweeping assertion that the provision he selected was the "one advantage of extreme lateral range," he would have hesitated before stating it in so public a manner.

One of the most important problems that presents itself to the Military Engineer has thus been dismissed by a single sentence.

I would earnestly beg your attention to the following reasons why the increased lateral range imposed by my system, should be very carefully considered, and not dismissed in this manner, as of little value and only available in one case.

The problem of deciding on the proper number of guns to defend a position, is a very important one. Any system which enables the same number of guns to efficiently perform more work is, I would submit, a great gain.

The new system is not only capable of reducing the number of guns, but also of giving the same offensive and defensive power with fewer men.

A large reduction in the first outlay for works and guns is thereby made possible, and, what is of even more importance, a reduction of the garrison can thus be safely effected both in times of war and of peace. The economy effected by obtaining equal offensive and defensive power

with a reduction of men is, I would submit, of the greatest importance.

The Special Committee on Moncrieff carriages, after careful investigation, have reported that "one gun mounted on a Moncrieff carriage "may do equal work with *two or more* guns mounted behind shields." They have also reported that it is superior both in economy and efficiency to the existing system. Additional weight will, I am sure, be given to these conclusions when I mention that the above Committee was composed of the following Officers:—*President:* Major-General F. Eardley Wilmot. *Members*: Col. T. Z. Gallwey, R.E., Col. G. Shaw, C.B., R.A., Lt.-Col. H. Wray, R.E., Lt.-Col. H. Heyman, R.A., Lt.-Col. F. Close, R.A., Major H. G. Alderson, R.A.

In March, 1867, before the new system was tried, and had proved itself to be so thoroughly successful, Lieut.-General Sir J. L. Simmons, K.C.B., to whom the country is largely indebted for obtaining the first consideration of the system, stated that—"When opposed to shipping, there "is very little danger to be apprehended from vertical fire. In such "situations, I have no hesitation in saying that some plan such as this "of yours, if it succeed, will be an immense improvement on anything "we now have, and will be invaluable."

Colonel Jervois also bore testimony to its advantages in a lecture he gave in this theatre; and the late Sir John Burgoyne, and some of the most eminent of our Engineers, have done the same.

His Excellency the Baron von Scholl, whose name will have weight in this Institution, in a letter which he kindly wrote to me regarding the north-east coast of Great Britain, remarks—

"The determining how many guns are necessary to make a position "of the coast, and to repulse a hostile fleet is one of the most difficult "tasks of the Engineer. I have observed that this question in all "published papers, treating of the art of fortification is, as far as I "know, very much neglected, although it is very important, because if "we take too many guns, we offend against economy, and if we take too "few, all money spent is lost, and the Commander-in-Chief of the Army "often relying strongly on his defensive works, may find all his calcu-"lations rudely upset if the enemy succeeds. Therefore, many years "ago, I made long studies on that subject, for many supposed cases "(low or high coast, open sea with deep water, or only channels, direct "or flank fire, &c.), and always I found out that Engineers, before they "decide which is the number of guns to get with them the necessary "security without falling into extravagance, ought to make a careful "examination, not only of the locality (land and sea), but even of the "hostile position and of the number of guns which the enemy is able "to bring into action. If we intend to make resistance, we must know "how to get it; and in this question we always have to examine "what are the enemy's forces. Nevertheless, I would yet say at this "moment that if your carriages are chosen for the lower batteries, fewer "guns are required than in the case of using common carriages. My "own conviction is, that in a low position, where great lateral range is "required, the security of guns upon your carriages is *three* times "greater than with guns upon common carriages. But with respect

"to the fact that everything new finds for a long time a great many "adversaries, I would rather reckon the increase of security at *two* "instead of three times. Considering now that the effect is highly "dependent on the security, I would always say that, for instance, two "guns upon your carriages are equal to four guns upon common "carriages. This is a very considerable advantage, not only in saving "money, but what deserves much more attention, in economy of men, "who always are the dearest article, and especially when they require "such a careful instruction as those who have to work heavy guns."

Compare Lieutenant English's opinion in the following statement with the above authorities. According to him, "The one advantage "of extreme lateral range is to provide against the rather improbable "case of one or a small number of vessels attacking a number of heavy "batteries." And having assumed his dictum thus expressed to be as a matter of course correct, he proceeds to say, "But it is scarcely "worth while to discuss this case, for judging from any successful "sea-attack hitherto carried out, the number of vessels in a fleet "designed to attack shore batteries will always be considerable."

In plain English, this amounts to an assertion, that there is only one case where lateral range is of any advantage, and that such a case will never occur, the inference being, that a system giving increased lateral range, is of no use.

To admit this sweeping condemnation would be to assume that the fire of heavy guns in battery can only be advantageous when delivered to their direct front, a limitation which I deny belongs to the accepted principles of fortification, and which if allowed to have a substantial existence in the mind of a military engineer, would render him a very expensive, if not inefficient, designer of national works of defence.

The next point claiming attention is that of the comparative merits of open or casemated batteries for coast defence.

This expression is used here in a restricted sense. It is intended by the Lecturer, and at present by me, to apply to coast defence by heavy artillery against floating batteries on board ship, and the issue is narrowed to a comparison between open Moncrieff batteries on the one hand and casemated or shield batteries on the other.

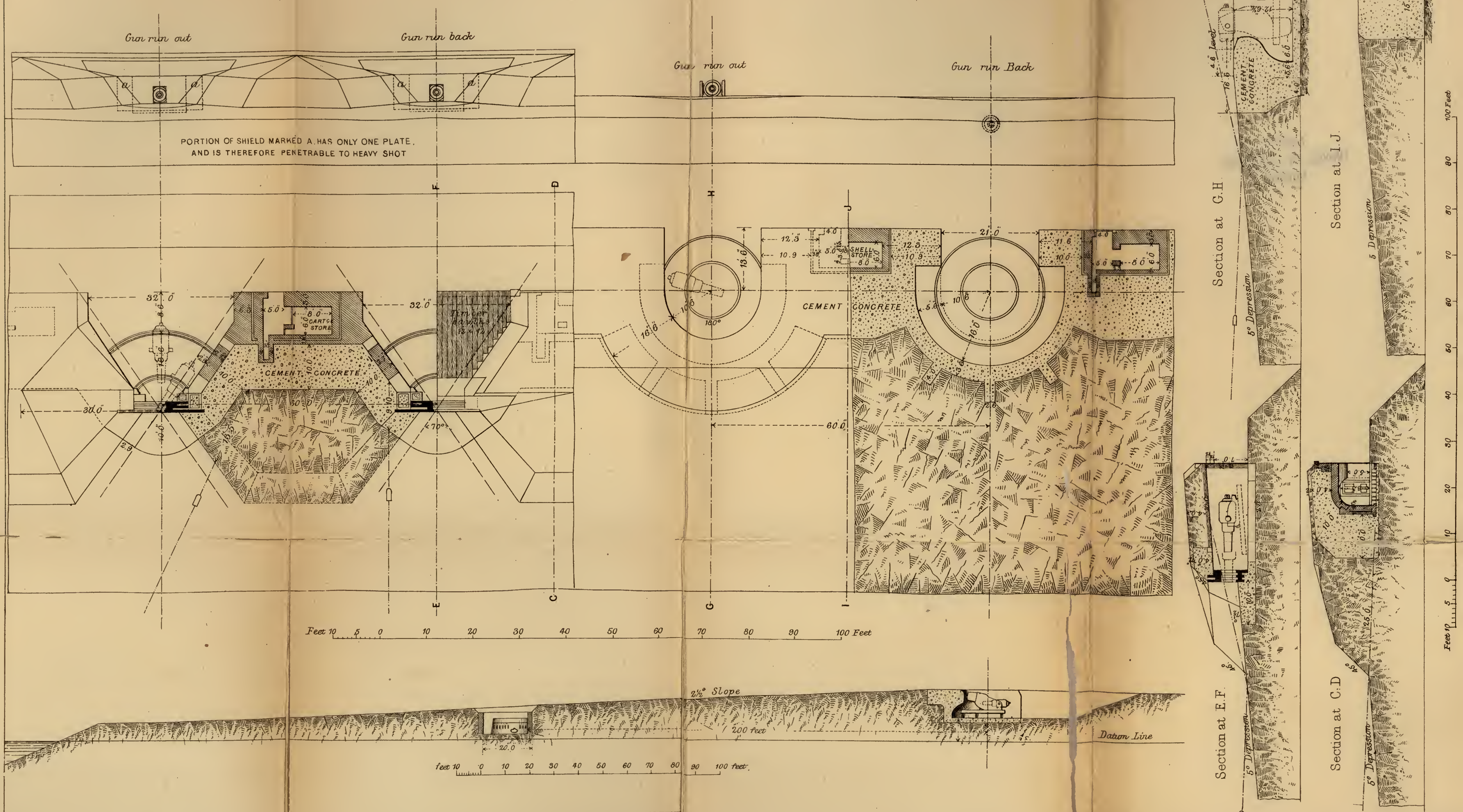
Lieutenant English remarks, "We can, however, by the help of "the reports of practice carried out for range and accuracy, form a "good estimate of what any piece of ordnance can do under the con-"ditions most favourable to it, and for purposes of comparison of the "defensive powers of the two systems as measured by the offensive "powers of the most dangerous fire that can be brought against each, "I think we can arrive at sufficiently accurate conclusions."

An example of the conclusions which Lieutenant English has arrived at is to be obtained from the figures in his tables.

"It may be assumed," he proceeds to say, "that the vulnerable "parts of a casemated work protected by iron shields consists of the "ports."

"As the port may be taken to be a rectangle of 2′—7″ × 4′—0″, the "greatest vertical target presented by it and the margin round it, may "be considered as a rectangle of 3′·7″ × 5′—0″, the breadth diminishing

A COMPARATIVE VIEW OF GUNS MOUNTED IN MONCRIEFF AND IN SHIELD EMPLACEMENTS, WITH THE SAME MAGAZINES, AT THE SAME INTERVALS, AND WITH THE SAME COMMAND.



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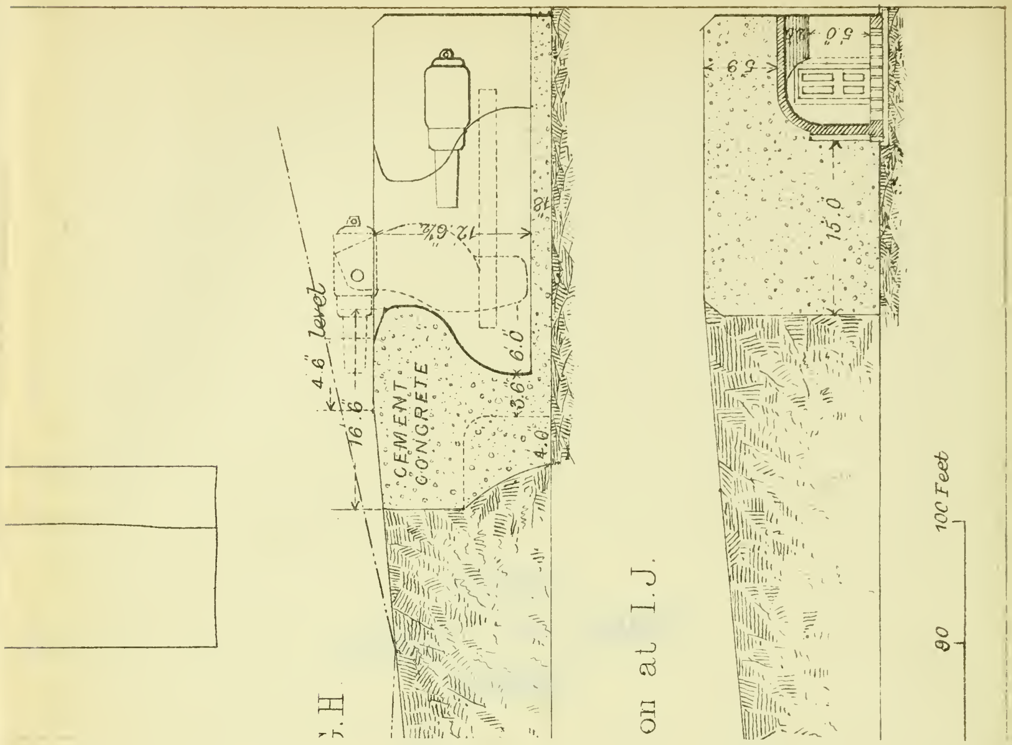
CEMENT CONCRETE
4.6" Level
16.6
12.6½
6.0
3.6
4.0
18
6.9
5.0
15.0
90
100 Feet
on at I.J.

"with the horizontal angle of impact." "In Table I annexed" (this is the one I have before referred to) "will be found the chances against "striking such a rectangular vertical target from a steady platform with "various natures of guns, at various known ranges, as calculated from "the series of rounds fired for range and accuracy at Shoeburyness." An ordinary shield battery presents an opening in the exterior slope of more than 200 square feet of vertical area to be fired at. A shot or shell striking at least one half of this area, is liable to be deflected into the port. I should therefore suppose that this liability has as much need to be considered as the chance of a direct entrance. A casemated battery is not in this respect so much exposed; it has, however, the chance of ricochet off the glacis to be considered, and the very serious consequences from shell, if it does enter the port.

Naval Officers, who I would suppose are the best judges of how naval artillery can be applied to greatest advantage, have stated that when land works are to be attacked, they prefer to reserve vertical fire for large objects, such as towns or batteries containing barracks and many guns, and that when they bring direct fire into play, they like to come to sufficiently close quarters to produce the required effect quickly, and above all, they like to see what they intend to attack. If this is a correct statement, I can only ask whether batteries consisting of casemates and open batteries with well-defined exterior slopes with swelling embrasures are the batteries, which are to their liking, or whether they would prefer to attack detached batteries with no pretention to an elevation above the line of glacis.

It appears to me to be only common sense that they would prefer to attack something on which they could observe the damage they were inflicting. The difficulties of determining the exact range at each moment from a moving ship is quite difficult enough, even with the advantage of clearly seeing the position of each gun on shore to make them dislike having to attack batteries which can only be distinguished in the act of firing by the smoke coming from the guns.

Lieut. English remarks in reference to Moncrieff batteries, "It will, "I think, be impracticable to hide the whereabouts of a heavy gun in "action; it is possible, no doubt, completely to screen its exact position "until firing commences, but it will be within everyone's observation "that the puff of smoke produced by the discharge of a heavy gun is "one of the most prominent objects in any landscape; also, at any rate "in this country, with the publicity afforded by the newspaper press to "every detail of the defences, it would probably be found in the event "of war, that the position and nature of every gun was carefully laid "down on the large scale charts of the estuaries and harbours with "quite sufficient accuracy to ensure the range and direction being "known within 50 yards from any position a vessel could take up."

Lieutenant English discredits the advantage of concealment belonging to the new system for two reasons, viz., that the newspaper press will give the position of the guns to within 50 yards, and because puffs of smoke are prominent objects in the landscape.

A miscalculation of range of 50 yards in firing at a casemate or shield is not serious because it would not cause a large error on a vertical

target; and if the error was short of the range, ricochet might give as good a hit as if the range had been rightly judged.

In firing at a properly constructed Moncrieff battery, however, an error of range, either sends the shot clear over the battery, or, if short, causes ricochet, which in this case amounts to the same thing; that is to say, that ricochet from the glacis of a Moncrieff battery sends the shot harmless over it.

With regard to the puffs of smoke, I should like very much to have an experienced sailor's opinion as to his ability to judge the exact range by taking angles on puffs of smoke during action on a number of guns firing at him, and perhaps with a breeze blowing, and whether he would not rather prefer to judge his range in action by seeing the effect of the shot on the exterior slopes of the shield, or casemate batteries, the hits on which can be easily observed, and the range corrected accordingly.

The newspapers may be able to tell the positions of the guns to within 50 yards; but if that is all they can do, the sailors, I suspect, will prefer other sources of information, and, instead of directing their fire by reading the newspapers, they are more likely to lay them by an observation on the ports of the casemates or shields they intend to attack. When such marks are removed by the application of the new system, properly applied, neither the puffs of smoke nor the newspapers will, I should think, afford them an equally acceptable substitute.

It would be a mistake to underrate the value of casemates, where casemates are absolutely required, and I should be very sorry to disparage the one advantage which casemates possess, viz., overhead cover. But at the same time, I am equally averse to arguments that almost indicate a disposition to create positions for the use of casemates; instead of using casemates only where that expensive form of battery is the best alternative.

I imagine that no one can deny that direct fire delivered from land batteries is more correct than curved fire. It will, I think, be also allowed that direct fire from floating batteries has, if anything, a still greater advantage over curved fire delivered from ships.

The comparative value of open batteries as against casemates is therefore greater on sea faces than on land faces.

This argument is valid when the comparison is only between open shield batteries and casemates. How much more so is it applicable when the comparison is between casemates and a new class of battery that increases materially the difficulty of range-finding and correct aiming, and thereby renders curved fire less effective, and, as a necessary consequence, reduces the value of overhead cover which is the only advantage over open batteries that casemates possess.

Is the overhead cover of a casemate employed for coast defence really so important that it justifies that form of battery being generally adopted for sea faces in preference to a new class of open battery, which has greater offensive power by means of increased lateral range, and from being less encumbered by its own smoke; is much more difficult to attack by curved fire than any other open battery, the range of which is easier judged; has a parapet which cannot be breached by

direct fire; in which the men are completely protected from direct fire by having no port; and which, notwithstanding all these advantages, is also much cheaper? I venture to think that if Lieutenant English had carefully weighed all these considerations, he would perhaps have modified the opinion expressed in the following sentence:—

"A comparison of the two methods of defence will, I think, show "that the best chance of success in the example of a fortified position "which I have selected is offered by the use of guns properly protected "by casemates."

The Lecturer stated that the "probable requirements of the future," when "vessels plated with thicker armour are constructed," and when a heavier shore armament is required, is an argument against my system. I should have thought that it would be a much more serious argument against iron-plated works, because increased thickness of ships' armour is likely to be accompanied with increased power of artillery; and whereas the former, that is the armour, is limited by the flotation-power of the vessels, the latter, viz., the guns, have no such limit to their increase of power; it would, I submit, be much more serious to find the shields too weak than the guns not powerful enough, and for the above reason it would not only be more serious, but would, in fact, be more likely to be the case.

If new and more powerful guns are in future required for some coast batteries, they can be mounted in the old Moncrieff emplacements, and the less powerful guns removed to new emplacements made for their reception in any position for which they are better adapted. These new emplacements would cost much less than would new iron batteries adapted for the dwarf traversing carriages which pertain to iron works. Besides which the old iron batteries, for the reasons above stated, would probably require to be strengthened for the new armament.

Lieutenant English makes a statement in his paper to which I wish publicly to take objection, as it is calculated to mislead, now misleads, a great many Officers, has prevented a comparative trial between my system and shields, and specially because it is constantly used as an argument for justifying delay.

The statement is as follows:—"A 9″ gun pit cannot fairly be com- "pared with a shield which has been found by direct experiment to "be completely proof against the 25-ton gun."

The words of this statement, as far as the iron is concerned, are true. It may, perhaps, surprise some of my hearers to know, however, that the comparison based on it is utterly incorrect and unfair.

The word shield may be used in two senses as meaning the mere iron, or it may be used for the whole shield emplacement; or, in other words, for that part of a shield-battery occupied by one gun.

The shield itself is no more than a block of iron with a hole in it, called the port. This shield would fall to the ground unless supported. It is by itself of no use. It must be fitted into a parapet formed of earth and concrete, or other materials, before it is employed. There must also be a platform provided for the gun and magazines, &c., for ammunition. When supplied with these accessories, it is then, and not till then, in a state to be compared with a gun-pit, which provides all such requirements.

It will perhaps surprise you, however, to be informed that a shield-battery in that sense "has not been found by direct experiment "to be completely proof against the 25-ton gun," as stated by the Lecturer, and that, so far from this being the case, a shield-parapet has not even been fired at or tried in any way. The vulnerable area exposed to direct fire in such a shield-battery is more than a hundred times greater than that exposed by a Moncrieff pit, exclusive of the cover with which it is proposed to furnish these batteries, and which is an additional element of weakness against direct fire. It is allowed that direct fire is more correct than curved fire, and yet the proposal to try the shield-battery by firing at it, is not entertained.

The shield-battery is accepted without a trial as perfect, with all its doubtful points, simply because the iron part of it has shown certain powers of endurance, while its rival, the pit, with fewer doubtful points, is alone to be tried, and the proposed trial has been used as a reason for delay.

Lieutenant English, while referring to the doubtful points which are to be solved by a proposed trial of a Moncrieff pit, is therefore contented to allow it to be supposed that the doubtful points in a shield-battery have been found to be completely proof against the 25-ton gun, the fact being that the iron, which is the strongest part of a shield emplacement, was alone subjected to the direct experiment he refers to. It will thus be seen that a wrong impression is created by coupling a fact with an irrelevant comparison. The only trial which would bear on the case was one made with the 13-inch shunt gun, which gave a maximum penetration into stiff clay of 50 feet. The thickness of a shield parapet between the magazine and the exterior slope is about 32 feet, 10 of which are of concrete; and there are weaker points in the parapet than the one in front of the magazine.

I would here wish you to consider another statement of the Lecturer—that "all shields which are not casemated are prepared for "the reception of over-head cover." These shields are, therefore, intended to be made into casemates before they are used. If they are to be made into casemates, surely it is worth while to try how they answer as casemates when exposed to direct, and I may also add, curved fire as well as the batteries which are now their rivals, and which are not so easily seen and aimed at by an enemy. I am extremely anxious to have both Shield and Moncrieff batteries subjected to experiment, as they are rivals; I have no doubt whatever as to what would be the result.

With regard to the element of expense. The Committee on Moncrieff carriages have reported that—"As compared with the cost of a case-"mated battery with shield, as estimated for a 9″ gun of 12 tons, the "balance in favour of the Moncrieff system would amount to about "£1,800 per gun, while as compared with an open battery with shield, "with and without splinter proof cover, the saving would be respec-"tively £450 and £667 per gun." The same Report states that "one "gun mounted on a Moncrieff carriage may do equal work with two "or more guns mounted behind shields." Mark what the effect of this would be in relation to expense. Every gun thus saved would be,

in addition to the above saving, an economy of the most important kind.

In the case of a casemate, according to the estimates in the report, it would save—

The gun	£769
Carriage	379
Battery	3,849
	£4,997

In the case of a shield battery—

Gun	£769
Carriage	379
Battery with splinter proof	2,642
	£3,790

To this saving, ranging from £3,790 to £5,000, must also be added the saving effected by reduction of men, which the Baron von Scholl estimates much higher than the first price of the works. I may here remark that the above figures are not mine, but they are taken from the official report based on the estimates of the Works Department.

If therefore the proper saving on each gun be added to the cost of those guns and works which can be dispensed with, and the cost of maintenance and garrisons required to work them, the total saving on each Moncrieff gun will amount to a considerable sum.

Lieutenant English alludes to my system as a cheap and imperfect one. It is to say the least extraordinary that he can do so in the face of the last Report on Moncrieff Carriages, which must be known to him to have pronounced in favour of "guns mounted on Moncrieff "carriages as compared with guns mounted in the ordinary way;" on the following points, which, it will be observed, include all that constitutes the efficiency of a heavy gun, viz.:—

1. Facility of loading.
2. Facility of laying.
3. Rapidity of fire.
4. Exposure to the enemy.
5. Protection afforded to the men.
6. Protection to the shell-rooms and magazines as compared with that afforded behind iron shields.

I venture to suggest that few military inventions of modern times have offered so fertile a source of efficiency and economy.

The objections raised by Lieutenant English have required so much space to answer them, that I am unable to do what would have perhaps made my remarks more interesting, viz., to have introduced you to new ground, and to new appliances for a further application of my system.

For this reason I must at present confine myself to a simple intimation that a new invention of mine for the Navy, employing hydro-pneumatic agency, which was announced here in 1870, and has recently been applied by Sir William Armstrong and Co. for the Dutch Government, has proved so satisfactory, that I have been able

to recommend its adoption in another form to land service for the heaviest artillery. This invention was first submitted to the English Admiralty in 1869. The success of my own experiments with this new system enabled me to give designs for its application to siege carriages for the English Government, at the request of the Committee on High Angle Fire; this application was alluded to by me, and partly described in this theatre on the 8th May, 1873.* The carriage referred to has since then been tried with success.

The success of these siege carriages will open up a new and interesting field of application unconnected with heavy artillery, and they may be found pregnant with important results. The other application of the same system to very heavy artillery, will in my opinion, also prove to be most important, and I hope on some future occasion again to bring it specially under your notice. It may interest you to know that when employed for guns of great weight, the cost which counterweight carriages for very heavy artillery imported with them, is removed. The system is entirely different from that which I was employed by the English Government to apply, and no assistance whatever has been afforded me by the Government in maturing it. This has led to a great loss of time; and in acknowledging the help I have received from the Dutch Government and Sir W. Armstrong and Co., I would state that but for that help, its application to naval purposes would have been a dead letter up to the present time. Some day it may be discovered that a very heavy expenditure has been incurred in continuing the manufacture of turrets, &c., that might have been saved by a more complete investigation of this new system. I wish to avail myself of this opportunity of publicly thanking Sir Wm. Armstrong and Company for the handsome manner in which they, after becoming acquainted with my principle, offered to guarantee to the Admiralty its successful action in the first application.

Mr. English remarks that "the Moncrieff system is as much in its "infancy now as iron plates were ten years ago." I would ask who is responsible for this? is it they who have consistently disparaged it and thereby kept it back, or he who, under difficulties and discouragements of no ordinary kind, has devoted his time, his means, and professional labours for its proper development in this country?

If the Moncrieff system in its infancy has proved itself to have so many advantages, what is it likely to be when it is as cordially and practically acknowledged as iron works have been? I have been restrained from feelings of delicacy from expressing in public my opinions on the way in which every trifling objection is allowed to cause delay; but when an Officer in Lieutenant English's position comes forward and openly discredits the utility of the work which I have been assiduously carrying out for the Government, I feel bound, in duty to myself and to the Departments I serve, to mention as much as I have done in this paper; and I have refrained from bringing forward more facts than are necessary to meet the case.

Besides extending and perfecting the counterweight system for the

* Lecture to Officers of the Auxiliary Forces.

Government, I have, as above stated, also developed a new one with my own resources which has already succeeded in each case in which it has been applied, and which promises to be as successful in all respects as the other. The new system has the remarkable advantage of being most useful where counterweight is not so applicable, as for instance in ships, in travelling siege carriages and for guns of very great weight.

Everything, therefore, connected with my Government work as well as with my own, is now satisfactory, except the delay. Each counterweight-carriage that I have designed for the Committee on Moncrieff carriages has answered beyond expectation, has required no alterations, except of the slightest kind, and all of them continue to work after great exposure and prolonged trials, as well as at first. The further the system has been applied, (as far as the carriages are concerned,) the better it succeeds. Notwithstanding this, it has not yet been allowed to go beyond a 12-ton gun, and the manufacture of those service carriages which are adopted, proceeds but very slowly. There must be some reason for this; what can it be? It is not want of efficiency, of economy, or of success—it is simply that the opponents of the new system have so much influence that they are able to instil doubt and cause delays. These opponents are the advocates of iron. The doubts which they have succeeded in raising, and the successful stand which they have made against progress, proves what very great influence they possess. That influence has hitherto been exercised without open expression.*

Lieutenant English has done good service in expressing so openly and so ably the opinions that prevent progress; but unless better arguments and stronger facts than his are adduced, I submit to you and to my countrymen, and particularly to those in Parliament, who are responsible for the expenditure of the public funds, that it is an injustice to me, and an injury to the taxpayer, to deprive the country of the full advantages of the new system on such grounds. I say *full advantages* advisedly, as in no case has it yet been applied so as to bring out its full advantages. In the defences of the Severn, of Cork Harbour, of Bermuda, &c., the Moncrieff system is largely employed. The Moncrieff batteries in these works, as they are constructed and placed, may be equal to, or better than, shields or casemates; but such of them as I have seen, are not by any means advantageous examples of the system they represent. This opinion was stated by me in my official reports.

I now appeal to the Officers of the English services who have so often supported me before, dispassionately to weigh the arguments on both sides, and if they see the truth of my views, to assist me in overcoming the passive resistance that opposes me at every point.

I appeal also to the sense of justice of my opponents as to whether it is right to cause delays in extending the application of my system to heavier guns, and at the same time to use as an argument for applying its rival, that mine is in its infancy.

* I should here wish to express my acknowledgments to the Works Department for urging forward the application of the new system at various times when it was all but standing still, and for the general support it has received from that department.—A.M.

I would also ask them if it is right to prevent a proper application of the new system which would illustrate its full advantages, and while doing so, to use arguments for applying casemates derived from the imperfect treatment thus imposed on their rival.

I would further observe that there is a large field of application for my system quite removed from the debatable ground on which the Iron and the Moncrieff systems have each got a foot, and that the controversy between the advocates of each system need not be allowed, as it is now, to delay applications of Moncrieff carriages, where no one disputes their superiority.

In my desire to meet the arguments and statements in the lecture, I trust that I have said nothing harsh or uncalled for to Lieutenant English, who I dare say can have no idea of the anxiety I have endured, and the difficulties I have had to contend with, in carrying out my system during a period embracing a good portion of a lifetime.

In conclusion, I beg to thank that Officer for bringing this subject before the public and lifting it out of the slough of despond, where it has too long been detained. I trust it will now remain before the public, open to the intelligent criticism of professional men, until every doubt has been removed and all fallacious arguments that have hitherto been permitted to carry with them undue weight, shall have been satisfactorily and conclusively refuted.

I cannot finish my remarks on this subject without gratefully acknowledging the support which I have received from the British Government. Their recognition has encouraged me to subordinate my private interests to the service of the State. It has given me confidence that when the time arrives, whatever is worthy in my system, will be fully acknowledged and properly applied. The pecuniary reward which has been bestowed on me is greater than has often been given to men of much more ability than mine for public services; and although I do not look to that form of recognition as my only aim, it has doubtless enabled me to do more justice to the calling I have selected; and I am not unconscious of the implied confidence which such a grant represents. It will be no small satisfaction to me to see the Government reap the full credit and advantage of the important step they took when they adopted my system, which will be the case as soon as it is properly applied.

APPENDIX.

Both the following extracts are from the Reports and Proceedings of the Ordnance Select Committee, which are in the library of the Institution.

The one from vol. iv gives the normal practice of the 9-inch 12-ton gun, and that from vol. v, as will be noticed, is special experimental practice, and is the table from which Lieutenant English quoted.

EXTRACT FROM MINUTE 18,991, 6/6/66. Vol. iv, Part II, page 130.

Rounds Fired from 9-inch Wrought Iron Rifled Muzzle-loading Gun of 12 tons for Range and Accuracy.

Date.	Number of rounds fired.	Charge, weight, and length.	Projectile.	Corrected elevation.	Mean recoil.	Time of flight corresponding to mean range.	Ranges. Minimum.	Ranges. Maximum.	Ranges. Mean.	Mean difference of range.	Mean observed deflection.	Mean reduced deflection.	Remarks.
		lbs. 30 ins.	lbs.	° ′									
May 11.	10	9·25	250·4	1 28	4·4	1·95	700	767	731	14·7	1·6	0·3	
„ 11.	10	„	„	3 14	4·3	4·03	1438	1539	1474	24·1	3·8	0·8	
„ 11.	10	„	„	5 9	4·1a	6·36	2239	2305	2283	18·0	5·4	1·1	
„ 11.	10	„	„	7 7	4·0	8·64	2905	3133	3034	51·9	9·9	1·5	

NOTE.—All the practice in the table from which this extract is taken was made for range and accuracy, and the portion quoted above is that on which the range tables for 9-inch rifled muzzle-loading guns were prepared for both land and sea service guns.

a. Mean of 9, 1 not observed.

EXTRACT FROM MINUTE 23,338. 21/10/67. Vol. v, page 320.

Practice with 9-inch Wrought Iron Rifle Muzzle-loading Gun of 12 tons, carried out in execution of several programmes combining the following points of inquiry:—

1/2/67. Part of 40 Palliser shot, 1·25D studs of an alloy of 7 copper,
1 tin
10 „ studs soft wrought iron
40 „ 1·5D, studs of the above alloy
10 „ studs soft wrought iron.

Trial of Various Forms of Head, and different Studs.

Date.	No. of Rounds Fired.	Projectile.		Corrected elevation.	Mean recoil on a dry platform.	Time of flight corresponding to mean range.	Ranges.			Mean difference of range.	Mean observed deflection.	Mean reduced deflection.	Compressor at hole.	Remarks.
		Brand.	Radius of Head and Studding.				Minimum.	Maximum.	Mean.					
				° ′	feet.	sec.	yds.	yds.	yds.	yds.	yds.	yds.		
22/8/67	5	A1	1·5 D. Soft wrought iron, rear of rear studs usual distance from base.	1 19	6·4	2·32	884	1035	940	43·8	1·8	1·8	3 & 5	
23/8/67	5	A1	1·0 D.	1 19	6·2	2·21	924	973	942	17·2	0·8	0·9	5	1 unsteady.
3/9/67	10	A5	1·5 D. 7 copper, 1 tin. Rear of rear studs 2¼ ins. from base.	3 10	7·1	4·79	1650	1960	1789	81·1	4·4	4·4	4 & 6	All noisy and unsteady. Compressor did not act for 5 rounds.
2/9/67	10	A5	1·5 D.	5 7	6·1	7·34	2450	2722	2633	79·6	6·2	5·6	4	9 unsteady, 2 jammed at 2 ft. from end of bore. Compressor did not act for 1 round.

NOTE.—The above extract includes the whole practice referred to in Minute 23,338. Lieutenant English's quotations are confined to that of the two last days.

The CHAIRMAN: Having heard Major Moncrieff's lecture, I invite Officers to offer any remarks they may wish to make. Perhaps some gentleman will also give us information on a subject which will not turn on the difference of opinion between iron shields and gun-pits, I mean with respect to the application of this principle to the armaments of ships of war and to guns for siege works.

Lieut.-General Sir LINTORN SIMMONS, K.C.B., R.E.: I have listened with great attention to the lecture which has been given to us by Major Moncrieff, and am sorry I had not the advantage of hearing Lieut. English's lecture; but I think we may come to the conclusion with regard to each, "There is nothing like leather." Major Moncrieff sticks to his pits, Lieutenant English to his shields, and both are making a very good fight for their respective *protégés*. I would observe, however, having had an opportunity of seeing the tables which were exhibited at the last lecture, that they are calculated somewhat to mislead. I may be wrong, the view I have had of them having been only very cursory, but they appear to be fallacious in several respects. First of all, as to the size of the target which is presented by an embrasure. The actual opening is 2 feet 7 inches by 4 feet, and reasoning from a shot fired some time ago at an experimental shield, which struck but did not perforate the shield within 7 inches of the open port-hole, Lieut. English adds 6 inches all round, and considers that a shot striking outside that line would do no injury to the battery. Now, I think this is slightly erroneous. In the first place the diameter of the shot must be added to the opening, which would make it very nearly 5 feet 7 inches in one direction and 6 feet in the other. Then I think what has been pointed out by Major Moncrieff on the board is a perfectly valid objection to these tables. There is a very large area, not only in the shield itself, but in the parapet which is vulnerable; and if open batteries are protected by extemporized overhead cover, which is not supplied by

the construction of regular casements, that area will be increased very considerably, because all the overhead portion will be exposed to direct fire, and if a shell were to go into it, it is very probable that it would be damaged and the efficiency of the battery might be seriously affected. Then as to that overhead cover, I do not know how it is intended to be constructed, but it appears to be partly timber and probably partly earth. Now I would observe that the effect upon it of heavy rifled shells fired at high angles has not been tried, and I should doubt very much whether such cover would resist the fall and explosion of two or three such shells; at any rate, a very large increase must be made to what may be considered the vulnerable part of the battery, by addition for the horizontal space in rear of the shields. It is not fair, in my humble opinion, to consider the port-hole and a small space around it in an open shield battery, as its only vulnerable or weak point. A large amount of effect should be allowed for vertical fire, which I believe would be very nearly equal to that to which the Moncrieff pit is subject. Next, as regards the 9-inch and 10-inch guns; I must confess I have been perfectly astounded at these comparative tables of practice. I have attended a good deal of practice myself and have seen a good many tables of practice, but I was not at all prepared for the general effect stated in these tables. It appears from Table I that the 9-inch gun, at a range of about 1,750 yards, is likely to throw one shot in 103 into one of these embrasures and the 10-inch gun one shot in 6·3. In other words, only at this range the 10-inch gun has sixteen times more accuracy than the 9-inch gun. This is a result I was not at all prepared for. A few lines farther on in the Table I find similarly that the 11-inch gun is ten times more accurate than the 9-inch at a range of about 2,650 yards. That also is a fact I was not at all prepared for; and I should like very much to hear what the constructors in the Arsenal have to say to this, because it is not at all creditable to them, if these facts be as stated, that there should be this great difference in the accuracy of these guns. I think the only conclusion to be drawn from these tables is one which has been known for ages,—that direct fire should be used to attack a work presenting a large vertical exposed surface, and vertical fire to attack a work which presents only a large horizontal surface through which it can be injured. There is, however, this great difficulty in attacking a work which only presents a horizontal target such as the Moncrieff battery, that it cannot be seen where the shots strike, and therefore there is no possibility of correcting the accuracy of the fire. If you fire at a work covered by a long glacis with a gentle slope at a range of 2,500 yards, or even less, you cannot tell from the deck of a ship, even with the best telescope, whether the shot strikes within 100 yards of the crest or not. That at least is my firm belief. The angle subtended at that range by even 100 yards of a gentle slope is so small that you cannot distinguish within that distance how near the shot strikes the object, and therefore there is great difficulty in correcting the practice if the shot fall short. If they go over the work still more, there is no possibility of knowing where they go to, nor therefore in this case also of correcting for range. Another objection that has been taken to the Moncrieff pit is, that an enemy would know from newspaper reports within 50 yards where every gun is placed. Granted this may be so; but there are two conditions necessary for accuracy of fire. It is not only necessary to know where the guns are, but also to know your own position with reference to them; and I should like to hear the opinions of the naval Officers present as to the chance of taking up a position in action and ascertaining the range of the guns within 50 or 150 yards, especially if there is not some well-defined object, such as an embrazure or a flag-staff, upon which to direct their instruments and take their bearings. I suspect also that naval Officers will guard themselves very much against remaining stationary when under the fire of land batteries. They will, I rather think, keep moving, if they possibly can, slowly, so as to bother the defender's artillery; but in so doing they trouble themselves; they are constantly changing the ranges of their own guns, which renders it exceedingly difficult for them to keep up a steady and accurate fire upon small objects, or those which present only a very limited vulnerable area. There are some positions in which iron shields may be used with great advantage, and there are others also in which Moncrieff pits may be used with undoubted advantage, but I think that engineers who are responsible for the construction of great works of defence should try to hold a neutral position, and after weighing the advantages and disadvantages of the various systems, should avail

themselves of the inventive genius of any gentlemen who devote their energies and talents to the service of the country in this way, and apply their inventions in those positions in which they may be used with the greatest benefit. I would observe, however, with regard to shields, that not only do newspapers give information of the positions of the batteries, but they even enter into such details as the amount of training of the guns in them. Now, if that be the case,—and I think it cannot be doubted that is the case, because all our experiments are made public and the whole world know them,—the construction of every shield in the service is perfectly well known as well as the amount of training that every gun mounted behind it, is capable of,—if that be the case, in attacking them an enemy will look as much to the training of the guns as to their position, and will try to place his ships out of the direct fire of the greatest possible number of guns, as was said by Major Moncrieff; and I think in that way, especially where the guns are intended for the defence of open channels, great advantage might possibly be taken of the knowledge of the lateral training of guns. The example that appears to have been taken by Lieutenant English as the basis of his arguments, namely, the defences of the Thames, is particularly favourable for iron shields; but batteries are intended, not only for the defence of narrow channels of that description, but also to protect open roadsteads and many other positions; and I think there can be no doubt that in many such cases the Moncrieff pit may be used with great advantage. I will only observe with reference to the last observations made by Major Moncrieff that I think it is very much to be regretted that we have not more experience of his hydro-pneumatic carriage. From what I have seen of the model, and from what I have heard of some experiments that have been made, it seems to me a most useful and valuable invention, not only for naval purposes, but also for land defences, especially where heavy guns have to be used. I should like very much indeed to hear the results of experiments that have been made, to know to what extent they have gone and what is the heaviest weight of gun hitherto mounted on a carriage of this nature, as I think it is an invention which is likely to be productive of the greatest possible benefit to the country.

Admiral Ryder: When your gun, Major Moncrieff, is fired with the hydro-pneumatic apparatus, is there enough force stored up to bring the gun up to its position again?

Captain Selwyn, R.N.: We have heard of the faint praise which condemns, and I think we have in Lieutenant English's paper a magnificent specimen of faint attack, which is a high compliment on Major Moncrieff's system. It was a paper which I confess did not at the time convey to me any great reasons for distrusting that which I have so long supported, that idea which first came before us in this Institution some years ago now, and has slowly made its way against a great deal of opposition; nor do I think that this evening's paper will give Lieutenant English any reason to think more strongly of his arguments than he did before. But there are some points on which I should like to answer Major Moncrieff's questions, as far as one member of the naval profession can do, and I have no doubt my brother Officers will speak further on the same points. Lieutenant English relies considerably on an idea that attacks by small numbers of ships on heavy batteries are abnormal. I think if we go back over the history of the old wars, when ships were not defended by iron, we shall find that it was a very favourite amusement with captains of frigates, whenever they had not much else to do, to run down the coast and attack any fort they could get near. In some instances they not only pounded them a little, but they landed, took the forts, and dragged the guns down the beach with chains, before the relieving troops could come up to help the battery. I recollect reading a very graphic account of such an attack, I think, under Lord Cochrane, when the guns were made fast by chains to the ship's capstans, and so hove off in spite of the attempts made by the enemy to sever the chains before the guns got to the sea. Such things were done then, and I think our modern sailors would not be reluctant to attempt at least the repetition of such feats. But in making those attacks, there are certain things which no sailor ever does if he knows his work. He never goes under a very highly placed gun, because, even though he may command an ironclad, a gun with great command can bore a hole through the decks, and out at the bottom. Nor is a very heavy battery to be encountered with great effect, if you begin a long way off; and all our successful naval actions, fought with heavy batteries, have been at the very

shortest range within which it was safe to anchor the ships. We are perfectly aware of the truth of what Sir Lintorn Simmons has said, that we cannot anchor ships particularly in a tide way with any very great exactitude; unless we moor, the current will sweep the ship about, and when we are at single anchor, the cable, being the radius of the circle at the extremity of which the ship moves the circumference of the circle in swinging, represents a very large possible error. That is still more the case where in rivers the currents change their course as the tide increases or diminishes in strength. That which I mentioned in the discussion on Mr. English's paper regarding the practice at a target at Gibraltar will serve to show that there are all these uncertainties attendant on the fire of ships, and that we do prefer very naturally, first, the largest target we can get, and, secondly, at least something that we can see. What we should not like, is precisely that beautiful green hill, out of which a gun ascends, delivers its fire, and recoils again totally out of our sight. With regard to lateral fire, there is a point which has not been made enough of in Lieutenant English's paper, and which deserves very great consideration from those who have to defend themselves against ship attacks. It is this, that a ship advancing up a river in passing a battery, and in continuing her course, is exposed to two different natures of fire, to one of which she has comparatively no means of resistance, and by which she is very easily hit; the other, for which she is specially prepared, and which she ought not therefore to fear so much. She advances end on, and if any shot at a long distance strikes anywhere within her own length, the ship may be said to have from 200 to 300 feet of length exposed of the deck, through which if a shot goes, with the curve due to long range, it is extremely likely to disable either her engines or screw. She suffers the same inconvenience after she has passed the battery. Therefore what she does is to advance to the battery as quickly as possible, if there be no torpedoes to hinder her, and then to deliver the full weight of her fire, and take the pounding she receives in turn when she arrives opposite the battery. There her armour stands in good stead, and she clouds herself in smoke, and trusts that the battery may kindly do likewise. Those are things which I think were left out in the consideration of Lieutenant English's paper, when he stated that naval Officers would prefer to moor some 1,200 or 1,500 yards off, and then concentrate their fire on the batteries. It is just what I should not do; I do not know what my brother Officers feel about it. The puffs of smoke which are so prominent an object on the landscape, are also very deceitful objects. I defy any man to tell me whether a puff of smoke is advancing towards him rapidly, or going from him rapidly, or with what rapidity when under fire. I defy any man to estimate by the angles of the sextant what the exact angle of a puff of smoke is with another puff of smoke, or with a tree, or some other such object. I should be very reluctant to base any accurate range-finding on such considerations; my calculations would be much more than subject to personal error. As to mooring within 50 yards range, I have shown it is utterly impracticable. I think we could possibly take up our position, even under sail. I am quite sure those Officers who have studied naval tactics recently with our present means of turning steamships rapidly, would undertake to take up their posts within something short, perhaps, of 150 yards, but they could not be certain that they would keep that, and it would sometimes be very inconvenient that they should keep it. Sir Lintorn Simmons has said we should prefer to move about a little, and to change the range as much as we could. With regard to the size of the port shown in these shields, I want to draw attention to the fact that gun muzzles have shown of late years rather a tendency to increase in size, and it is not quite certain if our ports are calculated as 2 feet 7 inches wide, that it will permit these new guns to be fired through them at all. It is quite certain, on the other hand, that all our experiments hitherto on granite and concrete have shown us that they are unreliable materials on which to base an idea of invulnerability. The shield proper is dependent for its retaining its vertical position, or its being perfectly out of winding, as we should say, upon the solidity of the concrete, and shots destroying the concrete at each side may very speedily block the whole gun fire, and this is a case which can never occur with the gun-pit. I can see a port, I can fire at it, and if I hit it I shall see more or less damage. But I cannot see the gun-pit, and when I do hit it I shall not know what I have done; there are no means of telling what effect my fire has had. Those are differences which sailors would consider as very great objections in their attack on a

Moncrieff fortification, and proportionately valuable to the defenders. The hydro-pneumatic carriage has, I must say, engaged my attention and my admiration more than anything else that I have seen come from Major Moncrieff's hands. He has there forced into his use for a particular purpose two separate mechanical appliances which have not hitherto been successfully combined on a large scale. It is quite clear that had the hydraulic force alone been relied upon, the shock given would have rendered the whole system impossible; it was clear, on the other hand, that with air alone, an efficient tight air piston is yet to be discovered; but by the combination of a water piston with an air-pressure, he has mastered a problem which I must say has, on the mechanical mind, an equal effect to that produced on the artistic mind by the master who produces a great work of art. He has given us a gun-carriage, too, and this is the valuable portion of it to naval men, by the use of which we can at last hope to have armour not dependent on the coming gun for its solidity of resistance. The coming gun nobody knows how big it will be. Not long since Mr. Bessemer told us he would not stop short at 600 pounds; he would not mind converting the pounds into tons at once. Under those circumstances we want some armour very badly indeed, which shall have a constant power of resistance, and be unaffected by any weight of metal. That armour is only to be found in the water; there is no other armour known that will resist such shot. But that armour is only available when the gun, the gun's crew, and everything else can be carried below the water, and can be brought up for use. We could not do that before, but Captain Moncrieff's invention has enabled us to do it. Whether it be in this little boat, or in the largest ironclad we now possess, I mean to say for the future no attention need be paid—and this was a question gentlemen present will recollect Mr. Barnaby put before us very strongly—no attention need be paid to the protection of guns or crew, the only thing that requires protection now is the life of the ship. I will only ask to be allowed to say one other word, and that is with reference to the advance which has been made by the Dutch. I recognise with great pleasure the fact that our old and worthy enemies on the water have been able to appreciate this invention. I am only sorry it should ever be said that the English constructors were led into the future by a Dutch gunboat.

Major KNOLLYS: Sir Lintorn Simmons put the case very impartially and fairly, showing that there are some positions in which the iron shields would be desirable, and others in which the Moncrieff pits would have the advantage. Nobody has given Engineer Officers stronger or better lessons in adapting means and appliances to circumstances than Sir Lintorn Simmons, particularly as regards fire. I refer to the works at Eupatoria. But I venture to think that though there may be some occasions on which the iron shield may be superior to the Moncrieff pit, as a rule the Moncrieff pit will be superior. I venture to go so far as to say that in my opinion Major Moncrieff's system has initiated a revolution in the art of fortification. I have a synopsis put into my hands directing me to impress upon those who attend my classes—I am a Garrison Instructor—the advantage of command. I am obliged to carry out my orders; but I always say in my opinion it is no advantage, but, on the contrary, a positive disadvantage, and I base that opinion chiefly on the experience of the Prussians round Paris. There they in principle adopted Major Moncrieff's system of protecting their guns, for the over bank system after all is only Major Moncrieff's system. They took advantage of the brow of a hill, and presented no sign of a battery whatever, and until the gun was fired the French were unable to tell that there was a gun there in position. With regard to the shields, there must be some limit to their strength, but in Major Moncrieff's system there is no limit whatever to the amount of protection given from direct fire by his pits. There is another very considerable advantage which has not been mentioned, which is connected with the repelling of descents on our coasts. For all the more important points we shall no doubt be prepared; we shall either have Moncrieff pits or shields, forts, and so on. But the enemy may discover some place where he can land his forces which has been overlooked by us. Now by making skilful use of the Moncrieff system, in a very few hours the most ordinarily trained soldiers of the Line would be able to construct cover for a large number of guns.

Lieutenant ENGLISH, R.E.: Major Moncrieff said a paper like mine or like his could

not be answered very well *vivâ voce.* I quite agree with that opinion, and must beg to be excused from offering any remarks on the general question, leaving my paper to stand with his, for consideration. But there are one or two points that I should like to remark upon. He alluded to the practice of the 9-inch gun as compared with the 10-inch, in the tables in my paper. The comparison was between the chances of striking a vertical and a horizontal target with the same gun in each case, and therefore it seems to me that the chances were fair; whether the shooting of the gun was good or bad it was the same for the vertical target as for the horizontal. There were some examples of extremely good, and some of certainly indifferent shooting, and, as a matter of fact, I did not pick the rounds, but took them haphazard.* I do not think, whatever they were, they materially affected the question. Then, with regard to the deflection of shot into ports by earth or concrete embrasures, Major Moncrieff said every shot that struck 200 feet of the flaring cheeks would be deflected into the port—— (Major MONCRIEFF: Half that area.) There are surely many other directions in which it would be deflected. Half, I think, is a very large proportion, and it must be remembered that the number of shields with flaring cheeks bears to the total number of shields in use, the proportion of one to twenty. I think Major Moncrieff said the thickness of armour must be limited by the floating power of ships, but that surely would not apply to batteries, and that the armour of land batteries would have to be added to from time to time. That is no doubt the case, but I do not think there is any material obstacle, except expense, to doing it. Sir Lintorn Simmons said, in the case which I had taken of a vertical target, where I had added six inches margin all round the port, that the diameter of the shot should have been added to that. In the experiment at Shoeburyness, from which the figures were taken, the point of the shot struck seven inches from the margin of the port only. With regard to ships being stationary or moving under fire, of course, as a landsman, one cannot be expected to give a sound opinion, but I adduced the case of the attack on Fort Fisher, in the American war, where I believe the whole fleet was anchored, one may say, for days together; and even if ships were not anchored, surely the change of position is as unfavourable to the accuracy of striking a vertical target as to that of striking a horizontal one.

Captain HOSEASON: There is one remark I should like to make, viz., that the argument has gone off a great deal on the difference between 9-inch, 10-inch, and 11-inch guns, but I understand Major Moncrieff is the inventor of carriages and has nothing to do with the guns; therefore if there is any defect in the gun it rests with those who furnish the gun, not he who furnishes the carriage.

Lieutenant SELBY, R.N.: I should like to ask whether the disparity of shooting with the 9- and 10-inch guns took place under similar circumstances of weather and on the same day?

Major MONCRIEFF: In answer to Sir Lintorn Simmons' question as to the weight of guns which have been mounted upon the hydro-pneumatic carriages, I beg to state that first of all I had manufactured for my own use and for experiments, a carriage for a 16-pounder gun, from which I got very satisfactory results. The next carriage made on that system was for a $12\frac{1}{2}$-ton gun. That carriage was constructed for the Dutch Government, and in this diagram there is a representation of the form in which it is applied. There is a hood not fully shown in the diagram which covers the gun and the Officers who direct it from musketry or shell fire. The gun fires over the bow on a non-traversing carriage. The working of the gun is satisfactory. It is true that the recoil does not carry the gun exactly to the loading position. This, however, is owing to the contraction of the hydraulic passages and valves of which I may say I foresaw the result; and I believe in the next construction the full recoil will take place. There will be

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* Since Major Moncrieff's paper was read, I have ascertained that the 18 rounds from the 9-inch gun referred to by him as fired with "shot with various forms of "head, and with studs of different kinds made of amalgams of copper and tin, and "even soft iron," were all fired with shot of the present service form of head, and with studs composed of the service gun-metal. (See "Extracts Ordnance Select Committee," vol. v, page 320, in the library of the Institution.)—T. E.

sufficient power stored up by the recoil in the form of compressed air to raise the gun again to the firing position. Indeed the action of raising the gun is one of the most easy that can be conceived. The gun can be raised quickly when the operator chooses, or it can be raised with such delicacy that I believe one could crack a walnut by the muzzle of the gun without breaking it completely. The third case in which this new system has been applied is for a 64-pounder siege carriage; this has been made for the English Government. The 64-pounder is probably the heaviest class of gun required for siege purposes, for this reason, that it approaches the limit of weight which two wheels will support on ordinary roads. Last week I conducted an experiment in the north of England with this carriage in which I obtained satisfactory results. From my experience of this new system in each application (and which has not as yet been carried further only from my want of power and means of applying it more rapidly), I think I may predict for it a very prosperous future. With regard to Lieutenant English's remark as to the deflection of the projectiles from the cheeks of the embrasures of shields, in my paper I stated that the vertical area of exterior slope exposed to be hit, amounted to 200 square feet, and that shot striking one-half of that area would be liable to be deflected into the port; this estimate, I think, is modest and safe; the angle of deflection of rifled shot is not always quite equal to the angle of incidence; this need not, however, decrease the liability of shot going into the port. Indeed I myself believe that the chances of a shot entering the port by ricochet are considerably greater than the chances of entrance by direct fire; but that is one of the questions which cannot be satisfactorily decided by theory, and therefore I regret very much that the authorities have so often postponed the trial of a Shield and a Moncrieff parapet. When such large sums of money are expended in the manufacture of shields and shield emplacements, I do not think it would be extravagance to discover what are the qualities of the parapets into which they are formed. I hope that experiments will be made not only with these shield batteries, but also thoroughly to test the Moncrieff system. I think I may allow the very favourable comments that have been made on my paper to answer all the other questions that have been asked.

The Chairman: It has been most happily stated by a Naval Officer during the present sitting, that Major Moncrieff has combined two forces, not wholly antagonistic, but each of which would compensate the varying elasticity of the other in the hydro-pneumatic carriage, and we have observed with great pleasure the uniform result of what I may call the smooth working of the gun-carriage. But I may remark here, especially, how great a power is to be derived from a scientific and thoughtful application of the forces of nature when the philosopher (and I place Major Moncrieff by right of his design in that class), when the philosopher converts the enemy into the friend and servant. Every Officer, particularly those who have had much practice in firing from granite works, even with guns on traversing platforms, must remember the constant vexation arising from, in the first place, the racers being displaced by the shock of the gun transmitted through the carriages, the injury to the carriages themselves, and from the continued difficulty of maintaining all on an equal level, in result of the vibration which tears the gun-carriage to pieces, and opens the seams even of a granite embrasure. But Major Moncrieff has, by converting this destructive agency into a friend and servant, placed the gun out of fire, and, in fact, has rendered a service to the manipulation of artillery which was previously unknown. It has given me particular satisfaction to preside on this occasion. I was one of the first, I believe, who had the advantage of becoming acquainted with the Moncrieff carriage. I remember well, though I was not present on the occasion, the first experiment made in public in Edinburgh, under General Hamilton. The gun was a 32-pounder, with an old-fashioned carriage; not the finished machinery that we here so much admire. In that case, so perfect was the absorption of vibration that the gun was scarcely moved a few inches. From that moment, it was clear that the hostile powers of nature had been mastered, and had been converted, under the guidance of science, as I have remarked, into a friend and servant. In conclusion, I would refer to the use that has been made of this system by the Dutch Government. There is no Government on the Continent of Europe that is more determined to increase and enlarge its artillery service, and its means of artillery defence, than the Dutch Government. An Officer, well known to the

artillery service, told me, the year before last, that he was at the great foundries in the north of Europe, and there he found a Dutch Officer superintending the casting of not less than 1,100 guns for the Dutch Government. Whether they were to be mounted on Moncrieff gun-carriages, I do not know; I trust that they will be, and that our countryman's fame will be displayed in the smallest fort that watches the entrance to the Texel or the Zuyder Zee. I should very much like to see some experiments of the combined action of the Royal Engineer Service and the Royal Artillery carried out on one of the most important points of the English coast, the point from which our future operations, if we are ever called upon to carry war into Northern Europe, must necessarily be based, and that is the harbour of Harwich. Sir Lintorn Simmons will be well acquainted with the nature of the defences of that harbour. A slight addition would make it impregnable to the heaviest iron-clads. The sea entrance is defended by a battery having four iron shields, covering heavy guns, two of which look seaward, one towards the fairway coming from the sea, and one into the harbour. There the iron shields would, I believe, be most useful, because the inshore course is such that an ironclad attacking must either come in and engage landward before it could proceed into the harbour, or it must lie outside the shoals and engage from a distant position. But there is a point still to be occupied for defence, which would, with impunity to the defending force, cover the entrance into the harbour. It is the Beacon Hill, and has a command of about 56 feet at low water. It is on that point I would suggest that one of the Moncrieff gun-carriages could be placed with perfect concealment. It is a place on which a battery was erected during the French war; it is a battery from which I have fired many hundred rounds, and from this experience I suggest this addition to the shore armament. For an extemporised defence of our coast, we must have also some field batteries answering to Sir Howard Douglas's mortar train. I was, therefore, particularly anxious that Major Moncrieff should give his attention to the transport along roads, without reference to railways, of siege or position carriages, and I understand from the siege or travelling carriage now exhibited, that it is available for this purpose, which appears to be of the very greatest importance.

Major MONCRIEFF: Sir, the question of applying my system for guns which are able to move about to different positions, was discussed by me in this theatre about a month ago, and the lecture that I then gave is now in print.* I should wish to express the satisfaction that I feel in having your Lordship as President at this meeting, as one of the very first men in England who recognised the importance of the system which I have endeavoured to introduce.

The CHAIRMAN: I believe I am only expressing your opinion in saying that we owe our best thanks to Major Moncrieff for the explanations he has given us. I think I should not fully express your feelings if I did not also add our satisfaction that British Officers may differ in opinion thoroughly, and yet meet to discuss the same with the most perfect advantage to both sides.

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* Lecture to Officers of the Auxiliary Forces delivered 8th May, 1873. Since published by Stanford, 6 and 7 Charing Cross, in a pamphlet entitled "Suggestions "for Supplementing our Coast Defences on the Moncrieff system."

LECTURE.

Saturday, May 31, 1873.

Captain H.R.H. The PRINCE ARTHUR, K.G., in the Chair.

THE TACTICS OF THE THREE ARMS AS MODIFIED TO MEET THE REQUIREMENTS OF THE PRESENT DAY.

By Captain H. Brackenbury, R.A., Professor of Military History, Royal Military Academy.

(Delivered at the Special Request of the Council.)

Your Royal Highness and Gentlemen: The glance which I have been able to cast round this room has increased the sense of responsibility with which I undertook to deliver this lecture, and I will ask you to allow me to say, before entering into my subject, that the position in which I find myself to-day is not of my own seeking. It was not until I had more than once very strongly urged upon the Council of this Institution, that they should place in the hands of an officer of greater experience and higher rank than myself this most important lecture, that I consented at their repeated instance to deliver it, feeling that there was a point where my objections must cease, and that at last it became a duty to comply with the request of so distinguished a body of officers as that composing the Council of this Institution.

We have now arrived at a period when the necessity for some change in tactics, as they have been practised by the British Army, is generally, I will not say universally, acknowledged. This desire for change has been brought about by improvements in arms; therefore, before we can arrive at correct conclusions as to what the change should be, we must examine those improvements. But first let us go for a moment to the very root of the whole art of tactics.

What is our object in battle? It is to break down the enemy's moral force, and to sustain the moral force of our own troops. As Laymann so well puts it, it is better to kill fifty men in an enemy's battalion, if that makes the rest run away, than to kill a hundred men if the rest stand firm.*

Now the means of demoralizing the enemy are practically two, fire and shock, either of which is helped and assisted by surprise. Shock has not increased in power since the middle ages; fire has enormously

* "About Tactics." By Captain Laymann, Instructor in Tactics at the Royal War School, Cassel. Translated by Capt. E. M. Jones; p. 9.

No. 1

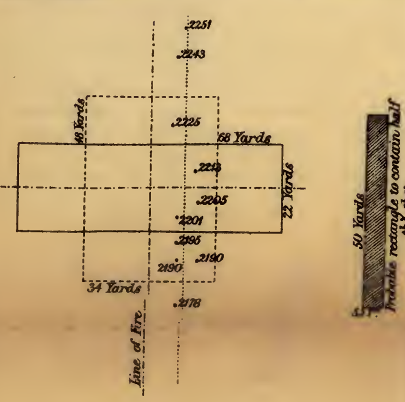
DIAGRAM showing the positions on the horizontal plane of the hits of 10 rounds fired from the 9 Pr. Rifled M.L. Gun, Charge 1 lb. 12 oz., Elevation 10°, Mean range 3292 yards. The rectangle shown thus ..... represents a Battalion in quarter distance column, its centre corresponding to the mean range. The rectangle marked with firm lines represents a Battalion in double company quarter column. The intersection of the lines marked ..... and ..... gives the point of mean impact.

Scale _ 40 yards to 1 inch

3318 (2) would have cleared the firm line rectangle, but struck the rectangle shown thus ....

No. 2

DIAGRAM showing the position on the horizontal plane of the hits of 10 rounds fired from the 9 Pr. Rifled M.L. Gun, Charge 1 lb. 12 oz., Elevation 5°, Mean range 2209 yards. The rectangle shewn thus ..... represents a Battalion in quarter distance column, its centre corresponding to the mean range. The rectangle marked with firm lines represents a Battalion in double company quarter column. The intersection of the lines marked .... and .... gives the point of mean impact.



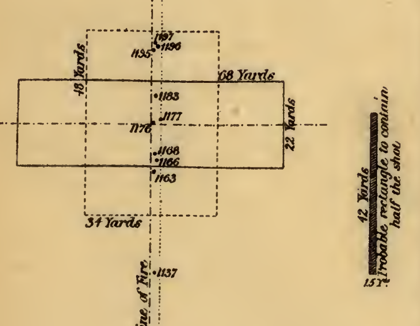
Scale _ 40 yards to 1 inch

2251 would have cleared both columns. 2243 would have cleared the firm line rectangle, but struck the rear of the broken line rectangle. 2225 would have struck the firm line rectangle. All the shots that struck in front would have done execution.

No. 3

ABSTRACT FROM REPORT OF SPECIAL COMMITTEE OF FIELD ARTILLERY FOR INDIA, 1869. P. 22.

DIAGRAM showing the positions on the horizontal plane of the hits of 10 rounds fired from the 9 Pr. Rifled M.L. Gun, Charge 1 lb. 12 oz., Elevation 2°, Mean range 1176 yards. The rectangle shown thus .... represents a Battalion in quarter distance column, its centre corresponding to the mean range. The rectangle marked with firm lines represents a Battalion in double company quarter column. The intersection of the lines marked ..... and ..... gives the point of mean impact.



Scale _ 40 yards to 1 inch

All the shots would have struck the columns either before or after graze

No. 4

EFFECT OF ARTILLERY FIRE ON LINES OF TROOPS.
9 Pr. AND 16 Pr. M.L.R. GUNS.

Line of targets 45 feet long by 9 feet high.

Range	Nature of Ammn.	Total hits 9 Pr.	Total hits 16 Pr.
1500	Common shell	46	36
do	Shrapnel do	92	345
2000	Common do	26	30
do	Shrapnel do	75	276
2500	Common do	24	36
do	Shrapnel do	100	131
3000	Common do	13	32
do	Shrapnel do	66	105

Front of a Company of 50 files, 34 yards long by 5 feet 6 high.
Front of a double Company 68 yards do do do.

No. 5

Return showing the hits *per cent.*, or destructive effect of infantry fire, with the Snider rifle, at the regulation targets, and the proportional effect on bodies of troops in different formations at various distances:—

Mark aimed at.		Ranges. 200 yds.	500 yds.	800 yds.
Battalion	In line	96·	80·5	59·
	Quarter column	99·61	98·05	95·86
	Double company quarter column	99·53	97·73	95·07
Half-battalion	Quarter company	99·41	97·09	93·85
	Double company quarter column	99·23	96·18	91·86
Double company	In line	95·89	79·93	57·79
	Company quarter column	98·77	93·99	87·32
Company	In line	95·77	79·36	56·57
	Half company column	99·1	95·56	90·59
	Column of sections	98·82	94·17	87·57
Regulation targets, 200 yards, 6′ × 4′; 500 yards, 6′ × 6′; 800 yards, 6′ × 8′		90·	61·	28·

Remarks.—At 200 yards the shooting is standing, at 500 yards it is from the knee, and at 800 yards in any position.

The battalion is supposed to consist of 800 men, divided into 8 companies of 50 files.

The calculations are based on the mean *individual* shooting of the infantry at the School of Musketry during the past year, and do not include the ricochet hits, which in actual war are as destructive as fair hits. Of course if the firing took place in mass instead of individually, it would not be so good. However, the ricochets would probably balance the deduction which would have to be made on this account. The shooting of the infantry at the School of Musketry is much superior to the average performances of the army generally.

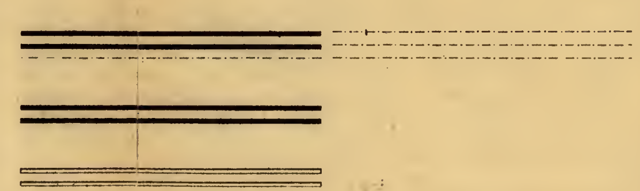
The results in this table have been obtained thus:—

Taking 200 yards as an example: the misses are 10 p. c. at a target 6 feet high by 4 feet wide. It is assumed that the percentage of vertical and lateral errors are inversely proportional to these dimensions, or 4 and 6 p. c. For any larger mark, such as a company in column of sections, the proportional per centage of vertical and lateral misses is calculated on the same principle, and the sum deducted from 100 gives the per cent. of effective hits. The depth of the column is considered equivalent to the height of a target of the same dimensions. It must be remembered that comparative results are here given. In estimating the absolute destructive effect of infantry fire, very large deductions from the above would have to be made on account of the distances being unknown, smoke, excitement, &c., &c.

School of Musketry,
Hythe, 30th May, 1873.

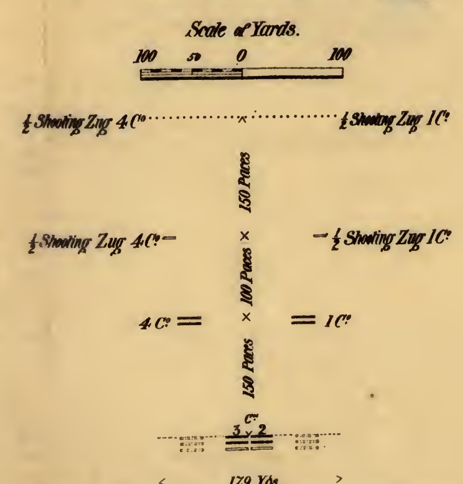
No. 6

FORMATION OF A COMPANY COLUMN.



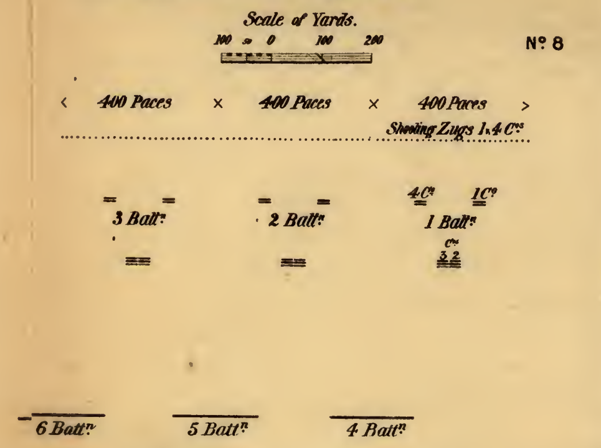
No. 7

PRUSSIAN BATTALION (800 Men) in fighting order.
(Vortreffen and Haupttreffen.)



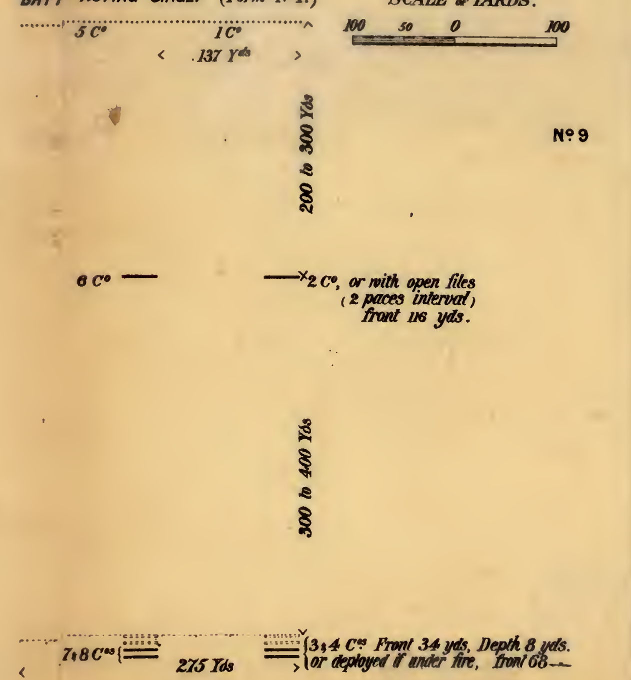
No. 8

PRUSSIAN BRIGADE (6 Batts.) in fighting order.



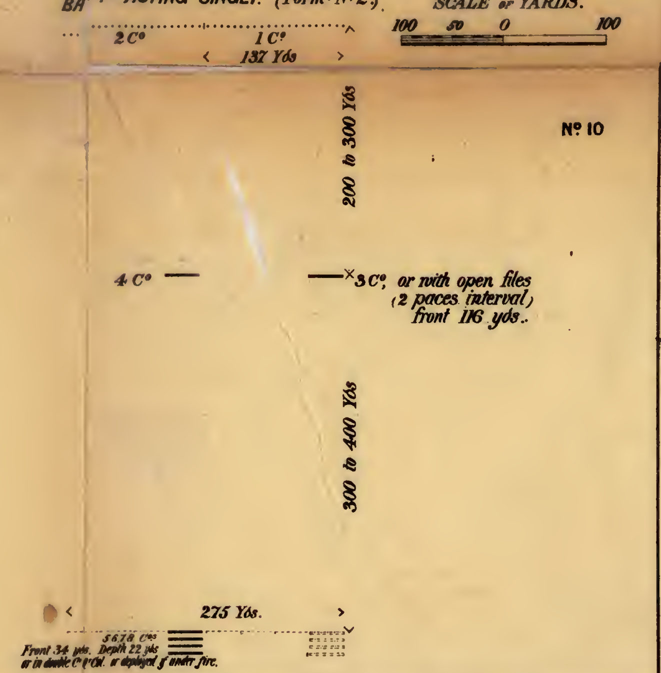
No. 9

BATT. ACTING SINGLY (Form. No. 1.)



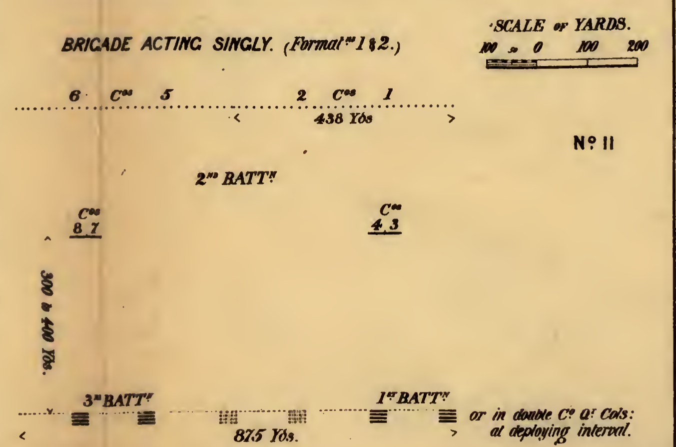
No. 10

BATT. ACTING SINGLY. (Form. No. 2.)



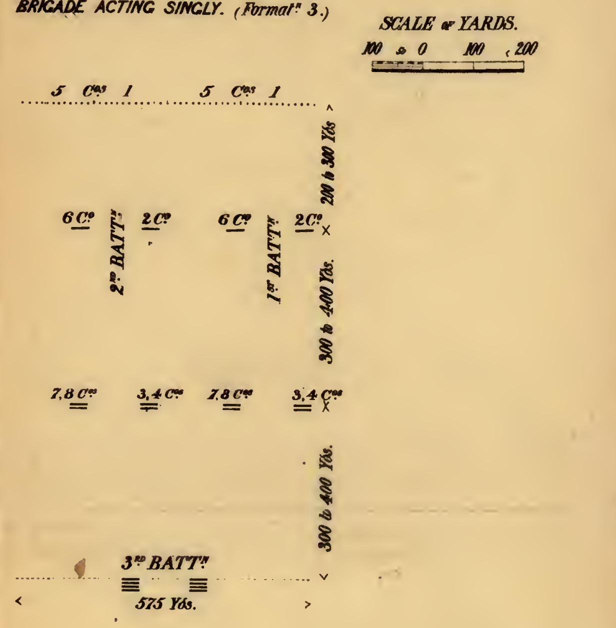
No. 11

BRIGADE ACTING SINGLY. (Format. 1 & 2.)



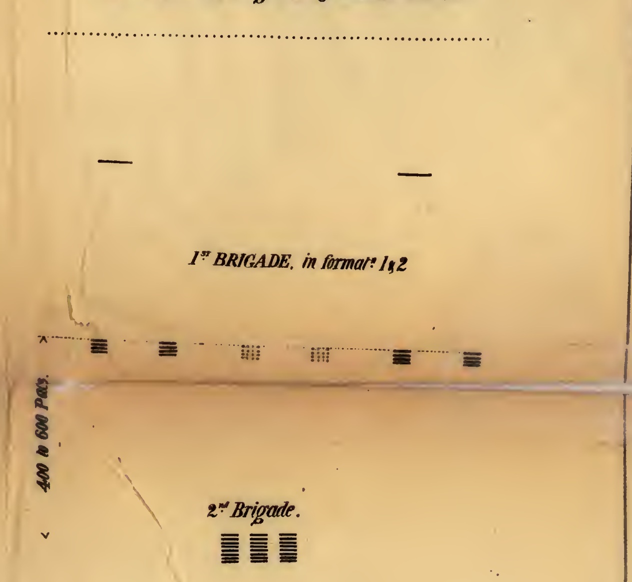
No. 12

BRIGADE ACTING SINGLY. (Format. 3.)



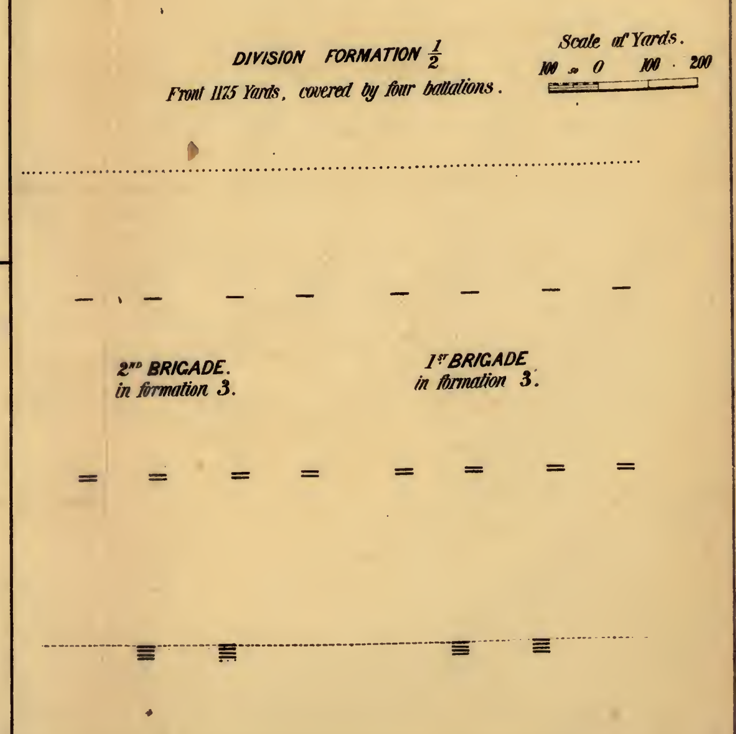
No. 13

DIVISION FORMATION ¼
One battalion covering front of division 875 Yds.



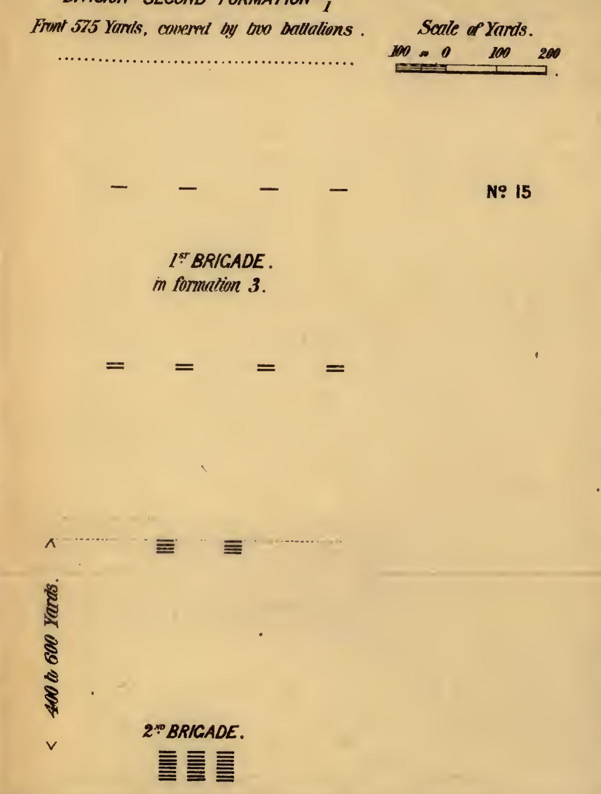
No. 14

DIVISION FORMATION ½
Front 1175 Yards, covered by four battalions.

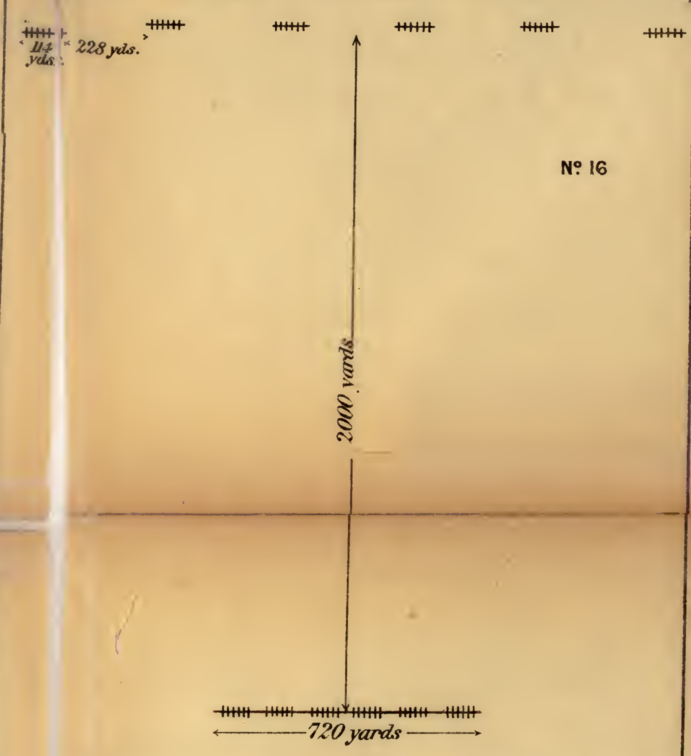


No. 15

DIVISION SECOND FORMATION ¼
Front 575 Yards, covered by two battalions.

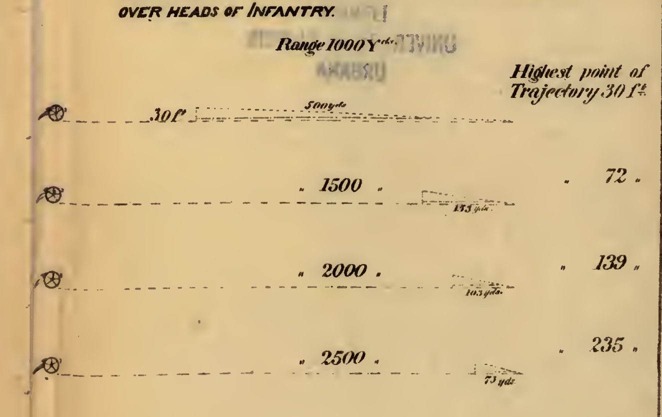


No. 16



No. 17

DIAGRAM SHOWING SAFETY POINT FOR ARTILLERY FIRE OVER HEADS OF INFANTRY.



The numbers given to the formations in Diagrams 9 to 15, correspond with the paragraphs and sections of the general order of 22nd March, 1873.

increased in power, and hence we find that the chief aim of modern offensive tactics is to obtain the greatest possible development of accurate fire, as being the surest means of breaking down the enemy. On the other hand, as fire increases in power, so does it become more difficult to sustain the moral force of our own troops. This is effected by the following means: first of all, discipline in its truest sense, not mere repression, but that discipline which, as Carlyle puts it, "is a kind of miracle; it works by faith:" faith of the men in their officers, not only in their courage, but in their skill; a discipline which does not give way at the moment that the soldier is removed from the immediate supervision of his officer. Secondly, training suited to war, so that the soldier is not paralyzed by finding himself in strange situations, but acts correctly from habit and from the knowledge of the best course under all conditions. Thirdly, giving confidence by success at the outset of war, for it is intensely difficult to re-establish moral force when once it has been broken by defeats early in a campaign. Next, protecting troops in action by shelter; using ground, natural cover, in the very best way, and if none such is available, artificial shelter under certain conditions; and also by moving troops, so as to take them out of the worst and most destructive shot spheres. Lastly, adopting those tactical formations in which troops suffer least from fire.

Now discipline, training, and success at the outset of a campaign are gained by our previous conduct and our organization in peace. Training during peace will alone enable an officer to protect his troops from fire when he leads them in battle. Tactical formations must also be decided upon in peace; all change at the outbreak of or during a war being likely to damage the moral force, and to shake the confidence of the troops.

In order to arrive at true tactical formations, the effect and power of fire must be truly estimated, otherwise false tactical formations are sure to be employed. Our own tactical formations up to the present time have been based upon the fire of the Napoleonic period. What was this fire? Infantry fire slow, very inaccurate; effective up to 200 or perhaps at most 250 yards. Artillery fire effective to about 1,500 yards, but shell power comparatively feeble, the greatest effect of artillery being really within the case-zone of, say 500 to 200 yards, before effective infantry fire was reached. Under these conditions we saw foreign troops attacking in such formations as that of Macdonald's column at Wagram, consisting of three divisions, one of which had its battalions deployed in one great column, the others being in contiguous columns of battalions on the flanks; or as D'Erlon's columns at Waterloo, four divisions each advancing in column on a front of a deployed battalion; or as Ney's right column at Friedland, with a front of some sixty-six files, and a depth of about eighty ranks. Our own troops, using the line formation, at times two deep, and at times four deep, (in which latter formation both the Guards and 52nd Regiment moved at Waterloo to repulse the last attack of the French Imperial Guard,) passing through the skirmishers who ran in, advanced over the comparatively short distances which separated the contending bodies of troops, and fired upon the enemy. The artillery, able to protect its

front with case, advanced to positions often half way between the elaborately drawn up lines of battle, whence it could effect by short-range fire the demoralization of the enemy necessary to allow a successful infantry attack, and then advanced when possible with the infantry. Witness Ney's advanced battery of 80 guns at Waterloo, Lauriston's and Drouot's batteries of 100 guns at Wagram, and Senarmont's wonderful advance of 30 guns at Friedland.

But how would these tactics suit the weapons of to-day? Let us look at the enormous change in the fire of artillery and infantry. Look at these diagrams,* for which I am indebted to Captain W. H. Noble of the Department of the Director-General of Artillery, and which represent the effect of artillery fire on columns of troops lying down. The dotted rectangles represent battalions in quarter-columns; the firm-line rectangles battalions in double company quarter-columns. Ten shots are fired from a 9-pounder gun, the field gun of our service. At a range of 3,292 yards seven out of the ten will strike the battalion in double company column, nine of the ten would strike the battalion in quarter column. At 1,176 yards we find the whole of the shot falling within the battalion quarter column.

Having thus seen the effect of fire upon battalion columns, let us examine this table,† showing the effect of artillery fire on lines of troops; and I would here observe that we have recently developed a projectile, shrapnel shell, the full effect of which has never yet been seen in war, even in the war of 1870; for the Prussians had no shrapnel, and the French had only shrapnel of an indifferent nature. Look how great, even at the range of 3,000 and 2,500 yards, is the effect of shrapnel upon the lines of troops. Make what deduction you will for the extra height of the target, yet you must admit that the effect of the fire will be terrible.

I have here also a return given to me by Colonel Bythesea, the Chief Instructor of the School of Musketry at Hythe,‡ showing the effect of infantry fire upon troops in various formations, which well deserves your careful attention.

Now, I am thoroughly aware that these returns, both of infantry and artillery, do not really represent what takes place in battle, because we never get anything like this accurate fire in consequence of the excitement and the smoke, and the difficulty of laying guns correctly in action. But still they do show us what an enormous power this fire possesses as compared with the fire of the past; and we must remember that it is not only in range and accuracy that the infantry has gained, we must think also of the immense development of rapidity of fire.

If such results as these could really be obtained in battle, it is not too much to say that troops could not move under fire, or that if they attempted to do so, they would speedily be annihilated. But the actual

* See Diagrams, Nos. 1, 2, 3. The battalion is supposed to consist of 800 men, divided into 8 companies of 50 files.

† See Table No. 4.

‡ See Table No. 5. The return was prepared at very short notice by Serjeant-Major Reid, and does not pretend to scientific accuracy.

results are so great that the front of a position held by troops in good order is, *so long as those troops are not demoralized by fire*, practically unassailable by troops in any close formation, if the attacking force has to pass over open ground, as we may fairly assume it will always have to do for a greater or less distance.

I want to show this by some examples; and here I would venture to remind you that as the British Army is without practical personal experience of the effect of these modern weapons in battle, we must borrow from the experience of other armies. Of all those armies the Prussian has had the greatest experience, and we can study both that experience and its results in detail; and we may learn much from the experience of the Austrians in 1866, and the French in 1870. None of these nations attempted to attack in these wars in the dense column formations of the Napoleonic period, but both Austrians and French did attack in line, and the Prussians did at times use whole battalion columns and lines of smaller columns in close order, half-battalion columns and company columns.

Let me give only a few examples. Take the battle of Gitschin, in 1866. On the Austrian left at one important moment a Prussian battalion in battalion-attacking-column endeavoured to debouch from the village of Unter-Lochow against the Austrians, who, only armed with muzzle-loading rifles, were holding the edge of a plateau to the east. The Prussian troops had to advance over quite open meadow land. They found themselves completely unable to continue the attack. They advanced some distance, but suffered tremendously. The men became demoralized, and at last the battalion had to lie down on the open ground, while its leading ranks endeavoured to keep up fire against the Austrians on the plateau.

On the Austrian right, at perhaps the most critical period of the battle, when the Prussians had unduly extended their left wing, and had only one single battalion left in reserve behind the village of Podulsch, six Austrian battalions advanced from Tetschin, three of the battalions directed against Zames and three against the village of Diletz. The three Austrian battalions directed against Diletz advanced in two lines, covered by skirmishers. Two Prussian companies were placed in the orchards to the north-east of the village, supported by another company, and later by the skirmishers of two other companies, making altogether less than a battalion. The Austrians advanced in two lines with the utmost gallantry. At 350 paces they were received with a volley and then with independent firing, and though they continued moving, and were one of the very best regiments of the Army, they were forced, before they got nearer than 150 paces to the enemy, to fall back, and so demoralized that they fled at full speed. At the same time two battalions advanced in line against the village of Zames. That one single battalion left in reserve was sent to repel this flank attack, which would have been fatal to the Prussian success. Two companies reached the village, and repelled the Austrian battalions by their rapid fire.*

* Compare Austrian and Prussian official accounts of the campaign of 1866. To avoid using several maps, I took examples from the battle of Gitschin only. Nachod,

Take now some examples from the war of 1870. There is that well-known example,—it is not necessary with such an audience as this that I should describe it,—the Prussian attack of three brigades upon Saint Privat. They advanced with skirmishers to the front followed by the supports, and the remainder in two lines of half-battalion columns.* Those half-battalion columns are only six ranks deep, and what was the result? Even if the losses be not so great as the Duke of Wurtemberg tells us,† if the Prussians did not lose so many as 6,000 men out of 18,000 in ten minutes, which he tells us they did, we know that they were utterly unable, advancing over the open ground, to keep up the attack. And there is another example which I brought forward on a previous occasion in this Institution, to be found in Lieut. Maurice's Wellington Prize Essay‡, the advance of the 93rd French Regiment at Rezonville, when under only the artillery fire of a battery of 24 guns at 2,000 paces the regiment suffered so terribly in its attempt to advance in line that it was utterly unable to maintain the attack.

What was the effect of this experience on the Prussian tactics? Whereas in the infantry instruction book in use previous to the war we find, "The attacking column is the foundation of the fighting formation "for the infantry, as it is equally adapted to the order of battle for "attack, to the retreat when threatened by overpowering cavalry, and "for movements, etc. It unites in itself independence, strength, and "mobility, and it is therefore a fundamental principle that, as soon as "a battalion prepares itself for battle, it assumes this formation, with "the shooting sub-divisions in rear;"§ we find in the alterations in the instruction of infantry, issued after the war, "On account of the "intensity of the effect produced by fire, deep tactical bodies, such as "battalion columns, are not adapted to remain closed within reach of "artillery. Even half-battalions do not afford considerable advantages "in respect to reducing the breadth of the object of aim and increasing "the mobility."|| And again, the very latest order, issued last March, commences, "When actually under the enemy's fire, the employment of "battalion columns can only be justified by special circumstances. "The normal fighting formation of the first line is therefore to be in

Skalitz, Trautenau, Kœniggrätz, would all have afforded equally strong proofs. The large map of Gitschin (drawn by Serjeant-Major Porterfield, R.A.) used at the lecture, is not engraved here, as so many maps of the battle field have been published. Since delivering this lecture, I have been studying these attacks on the battle field itself. There, on the ground, one is struck with admiration at the gallantry which the Austrians must have displayed in the unsuccessful attacks on Diletz, as much as at the skill in adapting formations to ground which the Prussians must have used when they wrested the same village from their enemy.

* This is the formation given by Borbstaedt, who may, I believe, be considered a trustworthy authority for what took place on the Prussian side.

† "The System of Attack of the Prussian Infantry in the Campaign of 1870–71," by Lieut. Field-Marshal William, Duke of Wurtemberg. Translated by Captain C. W. Robinson, p. 17.

‡ "Wellington Prize Essay," by Lieutenant F. Maurice, R.A., p. 29.

§ "The Regulation Drill of the Prussian Infantry," translated by Col. Newdigate, p. 143.

|| "Latest Alterations in the Regulation Drill of the Prussian Army," translated by Col. Newdigate, p. 32.

" company columns."* In other words, the battalion unit is recognized as too large, and its fourth part is established as the real unit, the moment the enemy's fire is reached.

Having established this, let me read another sentence from the orders of 1871:—" Our infantry, well instructed in shooting, may repulse by " their fire every attack *in the front*, even of the most daring foe. The " conviction must be aroused and fostered in the infantry—that it is " unassailable in front, and has only something to apprehend when it " turns its back. An infantry, whose flanks are covered, not troubled " by losses caused by distant fire, opposing a *sang froid* volley fire to " the direct assault of the enemy, is invincible. The security of the " flanks is of great importance, and the further back the supports of " the first line are kept, the better will this object be attained."†

Here, then, is the absolute power of front defence recognized, as well as the necessity for small units, as soon as under fire, in moving to the attack. The same instructions recognize the weakness of the flanks, and the necessity of securing them by adopting a formation with supports kept far back to repel flanking movements.

Now having abolished, for fighting purposes, the battalion and half-battalion columns, the Prussians substitute company columns,—small bodies moving in formation only four ranks deep if the skirmishers are out, or at the most six ranks deep. And here let me call attention to what this company column of the Prussians is.‡ When its skirmishers are not out in front of it, it consists of three lines, each of two ranks, and when its skirmishers are thrown out, it is nothing but the line four deep, with which our Guards and our 52nd Regiment repulsed the French advance at Waterloo.

Having substituted " a flexible chain for an iron bar," an elastic line capable of seeking cover far better than a mass or a whole battalion in line, in what formation do these troops advance to fight? The fighting is carried on by what we call the skirmishers, and what they call the shooters; the bodies in rear become practically only reserves from which to draw troops to feed this shooting, fighting line. This is what the Prussians say of it:—" Fighting in skirmishing order will predominate " even to a greater extent, and the closed divisions will act almost " entirely as reserves. They should offer the means of fostering the " shooting fight, and must frequently adhere closely to its course in " their movements."§ And mark how these bodies advance so as to make use of shelter. Perhaps I cannot better explain this to you than by reading what Major Tellenbach says in his pamphlet on " The Art " of Operating under the Enemy's Fire, with as little Loss as possible." " The chief maxim in utilizing cover should be—That the attitude of " each individual man, and the formation of troops, must be in conformity

* Beyond the debt which, in common with the rest of the Army, I owe to Colonel Newdigate for his published translations, I have to thank him for sending me a MS. translation of the Prussian order of 24th March last, immediately after its appearance in the Militair Wochenblatt.

† Latest Alterations, p. 22.

‡ See Diagram No. 6.

§ Latest Alterations, p. 31.

" with the cover at hand, and change with the character of the ground. " Let us first consider ground which gives cover to a brigade in rendez- " vous formation, the brigade should move forward in that formation so " long as it has cover. If the ground changes, and the brigade no " longer finds cover, then it must spread out its battalions. In what " way? Exactly as the ground prescribes. Perhaps two battalions can " remain together, either behind or beside one another. Perhaps one " battalion must separate itself 150 paces from the battalion of direction, " the other 50 paces. Perhaps one battalion must move out beyond " the line of direction; the other remain behind it. Perhaps for one " battalion, the line formation may be advantageous, for another the " column, and a third may most expediently move forward in company " columns, or in yet more scattered formation; or the second line must, " even for a moment, double in with the first. If the ground alters, " the formation must alter."* And the principle is carried out into the company columns.

Look at this normal formation for the advance of a battalion.† The battalion forms company columns towards the centre. Two flank companies advance to fight. Each throws out half a shooting zug; that is followed by the other half, and then as a reserve follows the rest of the company column which is nothing but a line four deep. In rear, again, there is the second reserve or the main body, ready as a reservoir, from which to feed and to supply any want that may be felt in front. Now, see the gradual diminution of these bodies as the front is reached. And, let me add, the subdivision of command goes even further than the half zug, and there is a division into sections (and I believe this to be a most important point) of not less than eight or more than twelve men, each under a separate command.

Now, in what order will these troops fight? Suppose a fight opened by the skirmishers, how do the supports move? The last order is very distinct—"The troops in support may follow the shooting line in line or column"—that column being zugs—"half-zugs or sections, and, quite as an exception, also in file." In other words, there is no formation that you can imagine in which these troops may not move. And these rear bodies,—and, if we carry our illustration still further to the brigade, where we have three battalions acting in the front line and three battalions in second line, 400 yards or so in the rear,—how do these rear bodies move?‡ "Where the enemy's fire renders it necessary, " the *treffen* (bodies of troops) in rear must also assume an appro- " priate formation in order to lessen its effects. It may, therefore, be " suitable that these *treffen*, or certain of them, form wholly or partially " in company columns or in line. The companies may also deploy

* Upon the Art of Operating under the Enemy's Fire with as Little Loss as Possible," by Major Tellenbach. Translated by Capt. C. W. Robinson, p. 11.

† See Diagram No. 7.

‡ See Diagram No. 8. In this diagram each battalion is shown as covering 400 paces of front: that being the front suggested in Colonel Schellendorf's "inspired" reply to Captain May's pamphlet on the Prussian infantry, in 1869. The idea that a battalion when fighting only occupies exactly the same front which it would occupy if drawn up in three ranks on parade, is apparently quite exploded in Prussia.

" into line, or break into *halb-züge* or sections."* For these bodies in rear again exactly that formation which is best suited for the ground is left to be employed.

What, really, does this mean? It means that each body, as Tellenbach has said, is formed to suit the ground. There is no rigid rule. But who is responsible for the formation which these supports should take? The Officer in command of each body of supports. Who for these reserves? The Officers in command of each body.

Now the fight progresses. This shooting line gains ground. It may be extended to a flank rapidly by the movement of the supports, supposing that there is evident opportunity for extension to a flank. On the other hand, it may require strengthening in the centre, and there may be room somewhere in the line for a greater body of fire. The supports at once become absorbed in the line. How? They extend, and they advance on the responsibility of the Captain commanding each company, and if they are in smaller bodies than companies, on the responsibility of the officer commanding that body; and other troops come up to take their place. As the first supports become extended, others move up to take their place. Each moves up to his place in the fighting line with the certain confidence that his place in rear will be taken. There is no fear of want of support, for each officer is trained to understand the progress of a fight, and he does not fear responsibility. He is brought up to accept it, and he is trained to used it aright. *Thus, then, this shooting line is the fighting line.* It no longer merely covers the fighting line as before, but, I repeat, it is the fighting line. Fed by small bodies successively brought up in extended order, their places as supports being taken by fresh bodies drawn from the reservoir in rear, the fighting line may be brought to great strength. Little by little, bit by bit, it has been fed by troops not in close formation. Little by little it has worked its way close up to the enemy, and by this feeding system of the shooting line a superiority of infantry fire is established, and the enemy's troops are demoralized. Now mark what this shooting line has become at the moment when the final attack may be made, when possibly whole battalions are absorbed into this fighting line. It is a line, but not a rigid line. It is a line depending on conditions of ground—a line which has worked its way to this point in small bodies, in fighting order, without that fearful loss and consequent demoralization which must inevitably ever attend the advance, or the attempt to advance, of a rigid line of anything like its strength. It has reached its point, and it brings an overwhelming fire to bear, having arrived at that point by the only possible method by which troops can be worked close up to the enemy's front. Then comes the final attack—the rush of this reinforced line—this fighting swarm, closely followed by the nearest supports. The Prussian instructions thus describe it: " If the enemy's infantry appears to be shaken in its holding of any " part of this position, the shooting line with the nearest, but hitherto " concealed supports, rush forward in a quick and concentrated assault " upon this point; whilst these draw together in close divisions it must

* Extract from the Prussian Order of March, 1873.

" be the Officers' endeavour to get them quickly into hand, in order to " be able to resist the enemy's counter-attack. In the meanwhile the " divisions farther in rear follow up quickly."*

Such, then, is the system of tactics now employed for infantry attacks. It is based upon these two principles—recognition that the front of the position held by good troops is unassailable until they have been demoralized by the establishment of superior fire; and secondly, recognition that it is a useless waste of life to bring troops in close formation, except where there is shelter, under the enemy's fire.

Now, look for a moment at the advantage of this deep formation of successive bodies of troops. It gives the power of rapid support; the power of rapid extension to a flank; and flank attack, not only on a whole position, but partial flank attacks on part of a position become a consequence of the great difficulty of direct front attack. And see how the constant stream of further supports is kept pouring up from the rear to the front. See, also, how if the front line has to fall back, it falls back just like a system of outposts, on constantly increasing bodies of troops. It is sure of the ultimate moral support of closed reserves.

But now let us examine the conditions which seem essential to the success of this system of tactics. In order to perfect this system, there must be a thorough subdivision of the infantry into bodies of gradually diminishing size, each capable of independent action; for since fighting must be entered upon in extended formations, and fire is so heavy, and even the noise is so great, the difficulty of supervising a large body of men in the fighting line is vastly increased, while the necessity for careful supervision is increased also. Thus, the actual command in the fighting line must be in small bodies. Further out of fire, more men may be commanded, because the formations can be closer; but the superior command cannot be exerted over a wide front. It must be in depth rather than in width.

Again, in order to success, there must be the most thorough tactical training, not mere drill training, but tactical or fighting training. Theory must do something; actual fighting instruction must do more; for this system depends, I acknowledge it, on the skill of the officers commanding small units, on their coolness, and their knowledge of how to act under all conditions. They must act on their own responsibility, and that is so well put in a letter written to me by Lieutenant Maurice, on sending me a copy of his Wellington Prize Essay, that I venture to read it:—"I think, when you have read my essay, you will see " what I meant by saying to you that the cultivation of a habit of " independent action is our great tactical necessity. I quite agree " with you that it is a necessity in everything: but what I mean is " this,—make the question as dryly one of mere manœuvring facility as " you will, limit it to the mere mechanism employed in the ordinary " definition of manœuvres, and in *that*, this freedom of action is, under " present conditions, the essential joint on which everything pivots. " My contention is, that since we have now to deal with an organism, " not a machine, its very freedom of motion depends on the nature of

* Latest Alterations, p. 27.

"the vital power which is infused into each limb." And look at the vigour—the huge reservoir of mental and physical power that we have as yet more or less untapped in this body of junior Officers in the Army, all full of activity, and eagerness, and courage, and, let me add, of desire for responsibility and desire for instruction. Think what an organism the Army becomes—no longer a mere mechanism, but an organism full of vital power in every limb. You know how the Prussians recognize this; you know how they meet it.

I hope to hear from those who oppose this system of fighting their objections in the course of the discussion after the lecture. I have only heard one or two. One is, they say that steadiness is lost in this system of fighting. Steadiness, they say, is the British soldier's characteristic; line formation suits it; therefore, keep to line attack. What is steadiness? Is it not moral force? Is it only to be had by keeping men in close order under the officer's eye? Was not the skirmishing of our light division in the Peninsula steady in the true sense? No one doubts the troops are more under control in line, but when, as I hold, and the Prussians hold, the fire of the present day is such as to destroy the steadiness of any troops in the world in a close formation at effective ranges on open ground, what becomes of the steadiness then? As a formation under some conditions undoubtedly line is the best. Stationary under artillery fire, for troops lying down, it is admirable, but as a fighting formation is it not fatal to the chances of the troops who try to use it in the attack? The Germans say 30 per cent. is the maximum loss troops will sustain without flinching.* Add what you will, out of national pride, for British troops; for the British lost 50 per cent. at Albuera. But are our troops better now than then? And is it possible to advance in line to close range under that fire which I have shown you, without far more than even that loss?

Another objection that is made is with regard to the mixing of troops; but is not this deep formation the very best security against the mixing of troops, for it is not until every man of the battalion is used up in a comparatively short front that any real mixing of the troops of another battalion may take place with them. And how was it with regard to the mixing of troops in our own fighting in the Crimea? It was but the other day that Sir Alfred Horsford said to me, when I was speaking of this question of mixing, "It must always take place. I commanded "a green jacketed battalion at the Alma, and very soon I had as many "red coats as green coats to command." And, Sir, sitting next to you is an officer who commanded a company of the Guards at Inkermann,† and I would ask him to tell us what is his experience of the mixing up of troops.

I now turn to an important question. There has recently been issued an order for experimental formations of the British troops, which is held by all students of tactics as the first great step to meet the necessities of modern fighting. The different formations for the battalion acting singly, for the brigade acting singly, and for the division, I have endeavoured to draw here as accurately as I can, working them to scale,

* See Laymann, p. 5.

† Colonel Stephenson, C.B., Commanding Scots Fusilier Guards.

from the order as it originally was given;* and I must point out at once that the difference of distance between skirmishers and supports, and supports and reserves, in the Prussian battalion and in the English, as shown in these diagrams, is simply due to the fact that these Prussian short distances are given for convenience of work on parade, and that the moment the troops pass to fighting in the field, these distances become extended to the same extent as our own. In fact, they depend entirely on the ground. Here we see in Diagram No. 9 the battalion first arranged in two half-battalion quarter-columns. Each sends out a company to skirmish and a company to support, and keeps two companies in reserve. Here we see the principle recognized, that the command in front can only extend over a short space, a half-battalion commander superintending in great depth these four companies. And here in Diagram No. 10 the principle is not recognized, for one half-battalion covers the front of the whole battalion. In this latter case the commander of the half-battalion has to superintend the fighting over double the front covered by him in No. 9.

Here in Diagram No. 11, of the brigade acting singly, our brigade being only three battalions, we have, in the first instance, the brigade drawn up in line of half battalion quarter columns, and then covering its whole front by one single battalion. That clearly is against the principle enunciated, that the command should only extend over a small front in the fighting formations of the present day. In Diagram No. 11, if you suppose the brigade merely to cover the exact space occupied by its three battalions in line, 875 yards, or half a mile, the commander of one battalion has to cover that front, while each of his half-battalion commanders would have to superintend the fighting over a front of a quarter of a mile. Here, on the other hand, in Diagram No. 12, we have two battalions formed as in No. 9, fighting side by side, as in the Prussian system, each covering its own front. There is here great depth of formation, and the principle is thoroughly recognized of the command being only over a small front.

In Diagrams No. 13 to 15 we have the division in two brigades. In No. 13, a single battalion acts in front of the whole division, and the difficulty of support in that case would, it appears to me, be excessively great; it seems difficult to know how the command is to be carried on over such a front as that. In No. 14, on the other hand, we have the two brigades side by side, each keeping a battalion back in the rear. We have thorough depth, and the command in the front line of fighting is well subdivided.

I hope there will be some discussion as to these formations. I bring them forward because the order is issued as an experimental order to be reported upon, and it must help any one who is to report to hear these things discussed by practical men. There are one or two points which strike me, about which I shall fearlessly speak. It appears to me that the essence of this modern system of fighting is, that responsibility should be extended to the commanders of the small units. I may be wrong;—but I do not see in these orders that the responsibility is allowed to extend beyond the commanders of the half-battalions. In

* See Diagrams 9 to 15.

the Prussian case, the commanders of the supports will move up on their own responsibility, and will change formation on their own responsibility, and the officers commanding bodies in rear will follow on their own responsibility. I do not think that that is recognized in the English orders. I shall be corrected by infantry officers if I am wrong, but I assume that there is no such responsibility here contemplated as that allowed to the captains of the Prussian companies in support, but that our captains have to wait for the order of the half-battalion commander. And, in the English orders, only two kinds of formation are allowed; one is line, and the other, line with open files, a yard apart.

If I may venture an opinion, this extension of responsibility must come, and the first thing to be done is to train the company officers in fighting, and the men in fire-discipline and in fighting-discipline. See how strong the Prussians are on this point. "In the above "rules, the demands of modern fighting have been taken into account. "I must, however, expressly draw attention to the following, that in "the instruction of companies, battalions, regiments, and brigades, Sec-"tions . . . . of the Regulations have to receive increased attention; "so that the multiplicity of units and the development of strong lines of "skirmishers do not lead to a disastrous loosening of the tactical "combinations. This danger can only be effectually opposed by an "intimate knowledge of the fighting formations on the part of the "Officers, and by a high degree of fighting- and fire-discipline, combined "with a well grounded and strictly carried out school drill."* I know the enormous difficulty that is introduced owing to the inability to use ground for fighting-training because it is in private hands; but this must be met in some way, if our Army is to learn how to fight under modern conditions; it must either be met by an Act of Parliament or the purchase of a large tract of available country for the establishment of a fighting school. And then, with this training, I dare not say before it, must come the extension of responsibility. Then we shall be able to "infuse that vital force into every limb." It is dangerous until there is the knowledge on the part of the officers of junior rank; it is dangerous until they have that power of control which they must get. Without that knowledge on their part, the troops would be badly employed, and defeat would be the result.

The same training is equally necessary for the defence as for the attack. To begin with, defence is never, or ought never, to be purely passive; it must pass at times and at various points into attack; and moreover, these same principles of deep formation prevail equally in defence as in attack. A position with clear open ground in front, such as gives the fullest opportunity for the exercise of modern arms, being chosen, this is how the Prussian instructions say it should be occupied:—"The strength which the front of infantry possesses through "the increased efficacy of the fire, points to the attack upon the flanks "as the weakest point in the fighting line. To obviate this danger in "the defence, a deep formation is especially appropriate. Divisions

* Extract from Prussian Order of March, 1873.

"kept in rear which are moved forward to the side, without even "moving into the proper line of fight, flank on their side the flank- "ing attack of the enemy. In a close country especially, suitable "divisions (companies or subdivisions) must be kept in readiness for "this in the rear, near the flanks of the firing line, as much con- "cealed as possible."* Time completely forbids it,—but if I had time, I would have shown how it is contemplated by Moltke to carry out this principle of deep formation in bodies of troops of all arms acting together—holding a front by comparatively small bodies of troops—and keeping the reserve far back, ready to move on the radius towards the threatened flank where the enemy who is to attack must pass round the circumference of which the radius is the defender's effective artillery fire.†

And now, although my lecture is on the tactics of the three arms, I do not propose to speak of cavalry. Colonel Baker has recently so ably treated that subject, and I agree so thoroughly with him that the *rôle* of cavalry is not now, as formerly, except under very rare conditions, to attack in masses in battle, but, that which demands far more intelligence and courage, to be the screen, the eyes and ears of the Army, that I do not propose to enter upon cavalry tactics, but will pass at once to artillery.

I must here touch on the question of attack and defence. How is it that, while the defence is apparently so enormously powerful, the attack ever succeeds? How is it that the attack is often held now by many tacticians to be still more powerful than the defence? Because of the power of the assailant to choose his point of attack, to concentrate his fire upon it, and to choose his moment of attack, while the defender must guard the whole position and really only knows at the last moment when or where the heaviest attack may take place. It is distinctly recognized, and were it not so, experience of these wars would establish it beyond question that in order to attack a position held by good troops with any chance of success, the attack must be preceded by long continued, and above all, accurate artillery fire. The attempts to attack positions without such previous fire led, especially in the wars of 1866, to losses out of all due proportion for the work done, and to failures in the attack. Nor indeed, in 1870, was it otherwise. The Prussian official account points to this as one of the chief causes of the heavy losses at Spicheren. It was undoubtedly so at Saint Privat; and subsequently it was the artillery firing chiefly which demoralized the French holding that position. I was told by the Officer commanding the Sixth French corps, who was familiar with what had taken place at the Alma, Inkermann, Magenta, Solferino, and Rezonville, that even he could not have imagined such a hail of artillery fire as there was in the position at Saint Privat, and that only the bravest men could stand long under it.

Now in those duels of artillery which precede attacks there is ample

* Latest Alterations, &c., p. 29.

† "Observations on the Influence that Arms of Precision have on Modern Tactics:" by Field Marshal Baron von Moltke. Translated by Lieutenant Craufurd, R.A., p. 17.

proof of the immense value of getting the initial superiority over the enemy's artillery. This belongs essentially to the defence in the first instance; for the defenders are in position and they can at once bring fire to bear upon any artillery showing itself, while the artillery of the assailant must be brought up in succession from the line of march.

There is, for the assailant, only one chance of meeting this, and it is to bring up masses of artillery early into action, to lose not one moment in inaccurate fire, or diverging wasteful fire, but to commence at once a heavy fire of many guns, accurate from the beginning, and at once concentrated on that one point which is most immediately important. This, then, requires three distinct conditions for success. First, that artillery must be near the head of the column of march. I do not dilate on this. I believe it is fully recognized as a tactical necessity. Prince Hohenlohe brings it out very strongly in his pamphlet. It is a matter of vital importance, and for the details of working out the position of artillery on the line of march I would refer to his work.* Secondly, the power of accurately and rapidly judging range and of firing with great accuracy. A good range-finder, and, in its absence, careful training gives the first. Careful training alone gives the second. And here I would urge the intense importance of making accuracy rather than rapidity of fire the tactical aim of artillery. Artillery, like infantry, is apt, under the excitement of battle, to fire hastily. Every shot so fired does more harm than good. It is so much ammunition brought up at great labour, and which may be badly wanted later, thrown away. Thirdly, thorough system of artillery command, so that guns may act with one object and not with various objects; may concentrate their fire and not scatter it, and that this object and this point of concentration may be such as best meet the requirements of the officer commanding the whole body of troops. This demands that an artillery officer should be in command of all the artillery of this body, whatever it be,—advanced guard, division, or corps,—that he should be with the Commander in the reconnaissance of the position, learn from him what he wants done, and then be responsible to him for its being done. Now this responsible task the Commanding Officer of artillery can only thoroughly carry out by himself superintending the action of his artillery, by supervising its action, not so far as to interfere with battery details, but giving such general supervision as will insure that the action of the batteries is in accordance with the plan confided to him. The battery commanders cannot all know the General's plan, hence their action must be confined to the carrying out of the orders of the commanding officer of artillery, for if they are allowed to choose their own objects of fire, scattering will be the inevitable result in lieu of concentration. Hence the great value of massing artillery. It acts with one object under the command of the officer commanding the artillery, whereas, if batteries are dispersed, the orders take much longer in transit, and it is almost an impossibility to prevent battery commanders yielding to the tempta-

* "On the employment of Field Artillery in combination with the other Arms:" by Kraft, Prince of Hohenlohe Ingelfingen. Translated by Captain F. C. H. Clarke, R.A., pp. 28—32.

tion to fire on bodies of troops in their own immediate front, their fire being thus lost so far as the general plan is concerned, the preparation of the important attack being delayed,—and such delay may be fatal.

Now, I know the argument against such massing, and in favour of separating batteries while concentrating fire. It is said that massed batteries afford a larger target than single batteries. But a single battery offers a front of 100 yards, and if artillery and infantry cannot hit a target with a front of 100 yards, it will be no use in the world to give them a wider one. If the argument were that it is better to keep single guns apart, I grant that a gun is a small target to hit, but I take it that there are no advocates for the separation of single guns. Another argument against massing is the question of oblique fire. It is said that oblique fire can be brought to bear on massed batteries by dispersed batteries. Now, if you will look at this diagram,* in which six batteries are placed against six batteries, 2,000 yards apart from centre to centre; where, on one side, 36 guns are massed over a front of 720 yards, and on the other side there are intervals between each battery of twice the front of the battery, the 36 guns thus covering a front of 1824 yards, you will see how very small, even in this case, is the advantage gained by oblique fire. And what would really happen in such a case as this? The commanding Officer of the 36 massed guns places himself with his telescope in rear of the centre of them. He has only 360 yards to each flank of his guns. He can despatch an order, even to his flank guns, in a minute. He says to his whole mass of guns, "First wipe me out No. 1 battery of the enemy;" then when he sees that a few rounds have had their effect, he says, "Wipe me "out No. 2 battery;" and so on in succession. Now, would it be possible that the opposing batteries, separated by intervals of front of two batteries, could possibly act with this simultaneous action? There would be a distance of more than half a mile from the centre to either flank.

It is, I believe, to this massing of guns and their consequent unity of action that the Prussians owed their great artillery success in the campaign of 1870, as well as to their great accuracy of fire. Colonel Smyth's paper, in the Royal Artillery Institution proceedings,† brings this out plainly enough. The account of the action of the 84 guns of the VIIth corps at Gravelotte, shows how the guns were handled. And read Frossard's tribute—the tribute paid by the Officer commanding the troops opposed to that battery. He says, "This artillery "had the advantage over us, not only in number of guns and in range, "but, why should I not admit it, in accuracy of fire. We could not "but remark their care in choosing positions suitable for their artil- "lery, in sheltering it from our sight, in rapid construction of shelter, "and finally in provoking, by a few apparently timid trial shots, our "guns, so that they ascertained the position and strength of our "batteries and then brought to bear on them a vastly superior number

* See Diagram No. 16.

† Proceedings of the Royal Artillery Institution, February, 1871, vol. vii, pp. 184, &c.

"of guns. In short, they did all that our artillery equally knows "how to do, but does not sufficiently practice."* It was by the fire of their massed artillery that the Prussians demoralized the 6th Corps at Saint Privat. Once this initial superiority gained—a superiority of artillery fire established—the enemy's infantry movements are nipped in the bud, as for example, that attempt to advance of the French 94th Regiment, which I have already described, at the battle of Rezonville.

A word on the choice of position for guns. Over and above the questions of shelter, clear view, and nature of ground, which every artillery Officer ought thoroughly to understand, and which are not much affected by modern changes, there enters a new element into the choice of position and also into the conduct of fire. From a study of the battle fields of the late war, I am thoroughly convinced that, except perhaps at the very opening of an action, when artillery has come into action before other troops, it is now almost constantly firing over the heads of its own infantry. At Woerth, Weissenburg, Spicheren, Gravelotte, Rezonville, it was certainly so, nor can I conceive how under the present great distances apart of guns and of the original formations of troops, it can possibly be otherwise. Artillery comes into action at, say, 2,500 or 2,000 yards, and even if later it advance at the sacrifice of thorough knowledge of range, and also of time, still it cannot advance with its infantry at a few hundred yards from the enemy right into the zone of effective infantry fire. Is it then to cease firing, because its troops have got within 800 or 600 yards of the enemy? What is really the danger? Study this diagram† which Colonel Owen has been so good as to work out, and if you admit that troops are safe when the projectiles pass 24 feet clear over their heads, then at a range of 3,000 yards, artillery may fire till its infantry is within 73 yards of the enemy; at 2,500 yards till it is within 103 yards; at 2,000 yards until within 153 yards; and at 1,500 yards until within, say, some 400 or 500 yards, for although the projectile is only 30 feet high at its highest point, the trajectory is very flat. Will not the point to which it is desirable to advance our guns be greatly regulated by the opportunity it affords of firing over the heads of our own troops? Come too near, and a flat trajectory prevents our firing safely over them, but well chosen positions may very much aid the power of continuing fire. Whether to advance at all from the first position, how far to advance, and in which direction, will be a point for the decision of the artillery officer in each individual case, bearing in mind the vital importance of keeping up the fire to the very last moment.

To what extent artillery can hold its own against infantry, is a point I should much like to hear discussed. If the infantry gets within fair range, say 600 yards, I am inclined to think that unless the guns are very well sheltered, they would soon be shut up. I could cite cases where, at various ranges from 800 to 400 yards, guns were compelled to discontinue firing; on the other hand, there are cases where they

* "Rapport sur les opérations du Deuxième Corps de l'Armée du Rhin, dans la Campagne de 1870:" par le Général Frossard, p. 116.

† See Diagram No. 17.

continued, though suffering desperate loss. The chief danger for the guns is when they are detached to the front, or are on the extreme flanks of the line. In other cases, they have for an escort the whole body of infantry fighting in their front, but when on the flanks, or detached to the front, they need an escort, cavalry and infantry if the ground is open, infantry only if the country is close—an escort not near the battery, but pushed out like outposts far to the flank to prevent the possibility of even the smallest body of infantry creeping up to within effective range. At Gitschin some Austrian heavy guns which took up a position in front of Zames were obliged to retire in consequence of hostile infantry having crept up the Cydlena valley and opened fire at about 400 yards.

That, under certain conditions, it is the bounden duty of an officer to fight his guns to the last, even though their loss may inevitably be the consequence, I firmly believe. Those Austrian officers, who, protecting the retreat of the army from the battlefield of Königgrätz, fought their guns till nearly all their horses and a great portion of their men were killed, surely deserved better of their army and of their country than if they had, before the horses and the men were killed, retired at an earlier period from the field of action. And see how the Prussians, again, recognise this. Read the close of Steinmetz's report on the proceedings of the 18th of August:—"I must draw especial attention to "the deeds of the artillery. It repeatedly silenced the enemy's guns, "shattered his positions, and exhibited great coolness and determination "under musketry fire. Hasse's horse artillery battery deserves very "special mention. This battery, although it had expended its ammu- "nition, had lost all the draught horses but six (out of 36), and "more than half the detachment horses (28 out of 48), never budged "from its position."*

Our guns are said to be our colours; I would it were not so. When a battalion holds its ground to the last, and leaves its dead by hundreds on the ground, retiring a shattered wreck, still fighting, it is highly honoured. When a battery fights thus to the last, its horses are killed, its men so reduced that it cannot carry off its guns as the battalion can its colours. Why should it not share the praise awarded to the battalion of infantry?

Another question of importance is the conduct of horse artillery in large battles; whether horse artillery is not better employed in being pushed forward and taking part in the general fighting, like those 24 guns of the cavalry division at Rezonville, than by being kept back with the cavalry and probably getting little or no opportunity of action through the day.

Again, a point of importance is the necessity of securing a position once gained by infantry, by at once bringing up guns. The stress which the Prussians lay upon this is shown by their immediately bringing up two batteries to the top of the heights of Spicheren.

Finally, I should like to say a word on the importance of retaining an artillery reserve. Hohenlohe does not, I think, sufficiently bring this

* "Die Operationen der Ersten Armee unter General von Steinmetz." Von A. von Schell, Major am Grossen Generalstabe. Berlin, 1872, p. 131.

out. The fact is, that the Prussians were generally so superior, either numerically or by the quality of their troops, that they never had their flank turned, and really were scarcely ever afraid of it. But suppose it had been otherwise, could a flank attack be met without guns to meet it with? And I would here again draw attention to Moltke's suggestion for the occupation of a position by an army corps, and show how much stress he lays upon the importance of keeping back guns in reserve, to meet flank attacks.

I have already exceeded the time given to me; but these tactical questions seem to me of the most vital importance. If an army enters into war with false tactical formations, it becomes, as the Austrian army did in 1866, inevitably demoralized, under the repeated failures of its attacks. We have, I believe, a very grave responsibility on us in this generation. If we refuse to accept that responsibility fully, and to meet the requirements of modern war, history will in turn speak of us as it does of the Prussians, who were defeated at Jena, of the Austrians who were defeated at Sadowa, and of the French who were defeated at Sedan. I know that against my opinion and against that of the Prussians in these questions of tactics, there are Officers of high rank, for whose opinion I have an unspeakable respect. There may be some who would not dare to speak out plainly, because of the weight of opinion which they know to be against them. But, Sir, as you know, I have lived for five months in a land overrun by its enemy, and I have seen that which has placed in my mind so deep and so intense a sense of responsibility, that the effect of this knowledge upon me is not that I dare not speak, but that, as I have said to your Royal Highness on a former occasion, when the opportunity to speak is thus given to me, I dare not keep silence.

The Chairman: Gentlemen, I now invite discussion on this very important subject, and, as time is of importance, I am sorry to say, I propose to limit the discussion to an hour at most. I will therefore ask those Officers who are kindly going to speak to be as brief as possible.

Major Colley: The interesting lecture we have just listened to, has dealt so thoroughly with the principles and the requirements of modern tactics, that it leaves me little to say beyond expressing admiration for the clearness with which so difficult and complicated a subject has been developed, and assent to almost every principle enunciated. The lecturer, I am glad to say, has fairly met the question,—to my mind the most difficult as the most important,—of direct or front attack. There was a time immediately after the great battles of the late war, and especially after the appearance of the Duke of Wurtemberg's pamphlet, when it was commonly said great attacks could no longer be attempted, and flank attacks only could succeed against the new arms. But on an extensive battle field where large masses are engaged and the fighting line covers many miles, it is evident that a very small part only can attempt flank attacks; the great bulk of the force must be prepared to attack to its front, or remain practically inoperative. Moreover, the defender may have chosen a position unassailable on its flanks; or, what is still more probable, have sufficiently provided for such contingency, and may meet it by a counter attack, outflanking the turning assailant. Flank attacks are not such certain roads to victory as some suppose. Had the positions in the late war been reversed, and the French tried such manœuvres upon the Prussians, it is probable we should have had a very practical lesson on the dangers of flank attacks, such as Frederic read them at Rossbach once before. We must accept front or direct attacks as the rule, flank attacks as the exception; dependent not on ourselves but on the faulty dispositions of an adversary, and the very

fact that the front attack is now so difficult, is sufficient reason for studying and training for it the more carefully.

Now, the principal difficulty which presents itself, and which furnishes arguments to those who object to what may be called the new school of tactics, is that of combining the loose formations by which alone we can derive full advantage of our own fire and reduce the losses inflicted by that of the enemy—necessary conditions, as pointed out by the lecturer, of modern warfare—with the closer formations which are necessary to give weight, vigour, and unity to the attack. We must face the fact, that in proportion as we gain in the earlier stages of the fight by the more independent and intelligent action of skirmishers, do we lose in the vigour and unity of the last rush. Men once broken up as skirmishers, or pushed forward in small bodies and intermingled in the fighting line, will not push an attack home with the same unhesitating instinctive obedience to their Officers' word, as those who have never been out of his hand. Hence the compromise supported by a large school of experienced Officers in Prussia, and worked out in our new drill formations, of strengthening, indeed, the skirmishing line far beyond what was formerly the practice, and feeding it up to a certain point, but still keeping the greater part of the attacking force in close formation for the final assault. It seems to me that to decide on the merits of the rival systems it is necessary first to determine which is the most important period in the attack. Scherff, perhaps the ablest exponent of modern views on infantry tactics, and whose work has already acquired a European reputation—for I see it has been translated into French, English, Russian, and Italian—divides the fight into two phases, the preparation and advance up to a certain point, and the execution or actual rush. The requirements of these two phases are, as I have shown, to a certain extent contradictory; and if everything depends on the final rush, the advocates of close order have at least a very strong argument for keeping the mass of the attacking force in the formation most suited to that rush. In former times it unquestionably was so—the "preparation" was often very insignificant, and the attack was carried through by the moral effect of a vigorous and determined advance long before the defender had suffered such losses as to compel his retreat. It is interesting as bearing on this, to study the traditions of the great armies of Europe and to find that they all, like ourselves, believe the bayonet to be their own special weapon. They give one another credit for superiority in activity, manœuvring power, calmness, &c.; but in this one point, a bayonet charge, each and all consider themselves unrivalled. This is merely the expression of the fact that whenever two forces had arrived within a certain distance of one another, that one which had sufficient morale, sufficient go left in it, really to wish and try to close, was *ipso facto*, victorious; and that every army, therefore, could boast that whenever it had really made the attempt to cross bayonets, it had been victorious. In those days, therefore, it was right to sacrifice all other considerations to that of bringing up the troops in such formations as gave most promise of sustaining the morale of the assailants and of shaking that of the defenders at that critical moment.

We know that we cannot now attack in that way, that much more careful preparation is needed; but have we yet fully realised how much of the result belongs to the preparation, how much to the actual rush or last advance? Unfortunately, we have hardly yet sufficient data, sufficiently detailed accounts of the infantry engagements of the last war to enable us to judge truly. But there are, I think, strong symptoms that infantry fighting is constantly tending more and more to assume the character of an artillery duel—a pure fire fight; that two bodies approach to within a distance at which their fire tells with full effect, and that beyond that, neither party *can* advance until the other is not merely shaken but has actually given way; that in point of fact the retreat of the defenders has usually *preceded* the final advance of the assailants and has been determined, not by the gallant rush of a body of men, whether formed or unformed, but by the intensity of the concentrated, sustained, and ever-increasing fire brought to bear by a dense line of skirmishers constantly fed from the rear. We are perhaps a little apt to undervalue American experiences, and attribute to want of manœuvring power and energy of attack on their part, the indecisive results which were really due to stubbornness of defence. But certainly the battles of the great civil war bear out the opinions expressed by American Officers, that no advance can succeed against good troops holding a fair defensive

position till these have been not merely shaken, but practically broken and destroyed as a fighting body. If this is so—if the victory must be really determined by what we call the preparation, and the last advance does little but reap the fruits already won—then I think it is evident that the principles of former days must be reversed, and all considerations give way to that of feeding the firing line and so developing to the utmost, the true offensive power of the new arms.

With regard to our own proposed formations, as I understand them to be only experimental, I may perhaps be permitted to call attention to those points which seem to me open to discussion. I see it is laid down that for the final advance, the line is to advance *over* the skirmishers, the latter closing as soon as the line has passed, and forming a reserve. Now, I would ask those who have had the experience I have not had, whether at such a moment it is desirable to leave any one behind? If the position is to be carried by fire, the fire of nearly half the force is withdrawn at the most critical moment; if by assault, surely the advance should be made with every available man. If the skirmishers have done their duty and pushed up to decisive distance, a few seconds almost, in these days of literal storms of bullets, will suffice to decide the result of the attack. If successful, it will be time enough then to close the skirmishers; if unsuccessful, no half-formed skirmishers can save the retreat; the defeated troops can only throw themselves under the nearest cover, or be rallied on fresh troops. The skirmishers can only affect the result by joining in the advance. Another remark I would venture to make, if I may do so without being deemed presumptuous, is that neither in the formations as laid down, nor in their ordinary application, is sufficient attention paid to the flanks of the skirmishing line. So long as the skirmishers were a mere screen to the fighting body, it was quite right that they should overlap it. But if we admit the skirmishing line to be the fighting line, and that the duty of the formed bodies is to feed and nurse it, then they should pay especial attention to that most delicate point in such a line, its flank—and formed bodies in echelon on the flanks of the skirmishers would not only secure the latter against their chief danger, but would be in the position where their assistance could usually be given with most effect, and at the same time when their losses from fire would be least severe. I trust, however, that I shall hear these as well as the other wider and more important questions raised in the lecture discussed by more competent authorities.

General Lord DE ROS: It was the farthest from my intention to address the assembly of Officers that I have the honour to see around me; but with the greatest possible admiration for the able lecture of my gallant friend, and the manner in which he has delivered it, there are one or two things I cannot help being very much struck with, and on which I therefore desire to say a few words. In alluding to the responsibility necessary, which he thinks ought to be thrown, upon the junior Officers in action, he seemed to question whether our young Officers were sufficiently trained and acquainted with their duty to be trusted with this responsibility. Now, I know it is the fashion of the present day to say our young Officers are ignoramuses, and that they have everything to learn—that the French, Prussians, and Austrians are all greatly superior in education to our young Officers, and possess a far more extended knowledge of their duties. I entirely and wholly repudiate that idea. I have been more than 52 years in the British Army, and I never have known of a young Officer called upon in any position who did not fully respond to all that was demanded of him. I would not venture to put my opinion forward as conclusive, but I will refer to a remarkable statement made by the Duke of Wellington before the well-known military commission of the late Duke of Richmond, about thirty years ago. He said then that there was no army in the world whose young Officers were so capable of responsibilities as our own, and he cited as an instance that at the time when there were annual transportations of convicts to Botany Bay, numerous bodies of those dangerous and desperate people used to be sent out in ships in charge of one ensign and fifteen men; and the Duke stated most emphatically that there was no service on earth where that could be done but in our own. I must mention one other fact; on the Military Education Commission on which I had the honour to serve two years ago, no clearer evidence was given before that Commission than by His Royal Highness the Commander-in-Chief. With reference to the education of young Officers for the staff, we asked him if he had ever known a regimental

Officer taken out of his regiment and employed on the staff who had proved a failure. He said he never had known one single instance of that kind. As regards the responsibility proposed to be thrown on the young Officers in the field, my gallant friend observed on the danger of separate detachments of artillery taking upon themselves to act independently of the supervision of the Officer in chief command, who but knew from his position what was wanted to be done. Is there no similar danger if you tell young Officers that they are to be totally independent of their Lieutenant-Colonels and are to go here and there exactly as they may fancy the ground most suitable? Is there no danger of their going far beyond or far short of what was intended? I think there is great risk in this, and I also think it is quite impossible for Officers on foot to command more than 150 men in the field. I do not care whether they are Captains or Lieutenants, it does require the activity and wider view of the mounted Officer to command men in action to any extent. An Officer on foot, no matter how quick in his movement or how loud and clear in voice, is lost; nobody can hear him, nobody can see him at any distance, or in any confusion, and I cannot think that it would be possible to give this independence of command to Captains' subalterns unless they were mounted in the field.

Colonel Hamley, C.B., R.A.: I will only venture to say, after the admirable paper we have listened to, containing as it did so many interesting points, so lucidly set forth and illustrated, that there is nothing in it which appears to me more encouraging than what the lecturer has said of the experiments which are in progress relating to the adaptation of troops to ground. Opportunity of this kind is all that we want to conduct us to the most valuable results. As Captain Brackenbury has said, we have plenty of officers, zealous, able, intelligent, and, best of all, as I venture to think, young. We have plenty of men who are well versed in the theory of war. There are Officers now present who have former systems of tactics at their fingers' ends, and who have watched with the most intelligent interest everything that has passed in recent campaigns. As to strategy, I am convinced there are men among us who, if they had been required to form a plan of campaign, say for the invasion of France, in 1870, and had possessed the same facilities and advantages as the German strategists, would have evolved a scheme not less sound and complete than that which we have lately admired in the official accounts of the German staff. But in tactics, theory is of little avail, unless supplemented by the adaptation of troops to the actual circumstances of the ground. To those who very naturally cling to our old traditions endeared to them as they are by so many glorious recollections, and handed down through generations of zealous and excellent Officers, I would, in the face of impending changes in the system which they love, suggest this consolation. Nobody can say of that system that it was calculated to develop in a high degree the intelligence of Officers or of men. A regimental career of 20 or 30 years passed in the practice of such exercises as we are all familiar with, far from fitting a man for responsible command, rather tended to dwarf and to narrow him; its tendency was to reduce the man of resource, energy, and ability to the level of the dull man of routine. And therefore it was that many of us have seen Generals who appeared unable to rid themselves of their regimental recollections, and who, instead of fulfilling their proper duties, seemed to find their highest zest in that kind of supervision of their troops which is best left to the company Officers, or even to the sergeant-major. Now I think that those who, like our lecturer, advocate the changes he has explained to us, may claim for them that they *are* calculated to develop in a high degree the best qualities of all concerned. The problem of adapting troops to ground under modern fire is one that calls for ability, resource, and readiness. It will bring Officers into closer and more favourable contact with their men; it is more varied and interesting; it produces the most practical results, for instead of making the drill-ground a mere scene of empty show, where many of the manœuvres practised bear little relation to actual warfare, it makes it a miniature battle field. Seeing, then, that these changes must come, and that they possess so many compensations, the best that we can hope is that they may be accelerated, and that they may take place under the most favourable conditions. There is one other circumstance connected with this lecture, which I should like to advert to before I sit down, and which appears to me of excellent promise for the future. The chair is filled by a Royal Prince, who entered on his military career at a time when these new ideas were springing up and taking root

around us. He is absolutely free from the influence of those traditions which many of us have found it so hard to struggle with. His training has hitherto been of a thoroughly practical kind ; I trust it may continue to be so, till he has passed through the higher grades of professional acquirement, and is fitted for command. And I trust, too, that if the opportunity comes, he may add fresh lustre to that name of happy omen which he derives from an illustrious godfather, and that he may vie with those warlike Princes of Germany who showed themselves such adepts in military science, and so sagacious in selecting capable men to aid and to advise them. This is no time to rest on traditions, or on the chance of discovering excellence which has been undeveloped by study. War is every year becoming more and more a problem to be studied. I venture to assure His Royal Highness that if, as a General, he should be in doubt or perplexity, or under the stress of momentous events, he will find, as those Princes found, firm supporters and able counsellors in those who have the most widely and deeply, and with the most open and unprejudiced minds, made a study of their profession.

Major-General M'Dougall: I am sure, Sir, we must all agree in the remarks with which Colonel Hamley characterised the lecture to which we have had the pleasure of listening. And we must all agree that the subject is one of the very highest interest and importance. The remarks that I have to make are of a general nature. In the programme with which Captain Brackenbury furnished myself and some others there is one proposition which he has ably supported—that a front held by good troops undemoralized is practically unassailable under the present conditions of fire. If this be conceded, then future campaigns will in all probability be decided rather by strategic than by tactical manœuvring. I may illustrate my meaning by quoting the following remark from a book published in 1864, recognizing the difficulty of advancing over open ground to attack even at that early period, immediately after the Danish war, when breechloaders first proved their value. "The "difficulty and uncertainty attending the assault of a position under the present "conditions will assimilate the strategy of every campaign to that which is the true "method of making war in mountains. The great art of a General, even in offen-"sive warfare, will consist in taking up such positions as, while they cover his own "line of retreat, will threaten the communications of his enemy, and so oblige the "latter to become the assailant." Now, although it is probable that this anticipation may to a great extent be realized in the future, it must be conceded that if the Prussians had been guided by that principle, they would not have gained the signal successes which they actually did gain, frequently indeed by a front assault on positions of great natural strength. It will be allowed, I think, that it is of great importance to the subject under discussion here to-day that the causes of the Prussian success should be rightly understood, especially in such a battle as that of Mars-la-Tour, where the French had all the advantages both in respect to position and numbers during the entire day; and again in the battle of Gravelotte two days afterwards, when the French position was such that at any time from early morning, when the Prussian turning movement commenced, up to 11 o'clock a.m., the French, had they taken the initiative, could certainly have brought a very superior force to bear against any point in the Prussian line of flank march which they might have chosen for attack. Now, the French troops engaged on these occasions were the best of the army, and from all I have been able to gather I feel in my own mind convinced that the causes of their failure were attributable partly no doubt, and also materially, to their extremely defective musketry training, but mainly and principally to the want of enterprise in their commander. The Prussian successes, therefore, on those occasions must not be taken as establishing the rule that it is wise or prudent to undertake the attack of strong positions in front, so long as any other course remains open for choice, the opinion of the Duke of Wurtemberg notwithstanding. In the remarks on the system of attack of the Prussian infantry in the campaign of 1870–71, published by the Duke of Wurtemberg, he says, "When, at "length, the news arrived of the brilliant storming of St. Privat by the Prussian "Garde—bloody though it was beyond precedent—which decided the battle of "Metz, now termed officially the battle of Gravelotte, there seemed to be no longer "a doubt that, even when opposed to the breechloader, the old charging tactics "formed the only effectual method of attack calculated to ensure victory." He

goes on to say, "The general voice of our own, as well as of the Russian army, "rejoiced that the old cherished system of charging in masses, which had been dis- "placed by the breechloader, had returned triumphant, and been reinstated in its "proper position." Yet almost in the next page he goes on elaborately to show that, owing to the very defective musketry instruction of the French soldiers, their assailants actually suffered greater loss when at a distance of between 1,200 and 1,800 yards than when they came to close quarters. The conclusion of the Duke of Wurtemberg that positions must in the future, as in the past, be carried by the old charging tactics, can only be accepted with reserve, because the conclusion is based on facts of an exceptional nature. But as no doubt circumstances must arise in which it will be necessary to take the bull by the horns, it is quite right that we should endeavour to ascertain the most prudent method of doing so. In the English service, the fighting unit is the battalion, and what we have to do, it seems to me, is to lay down the formation in which the battalion should advance to capture any part of an enemy's position which happens to be in its front. If we can arrive at this, I do not think there is any necessity for prescribing different modes of formation for a brigade according to the different number of battalions of which it is composed, because the tactics of a brigade will continue to be the same, and it is only the formation of the individual battalion that it is necessary to regulate. I believe that it will be found that a much slighter dislocation than is frequently proposed of our present drill system will entirely effect the object required. I hope it will, because I think anything like a great dislocation of an existing system is a misfortune. If we draw up a battalion in line at close order, the front, and the numbers of that line, represent the extent of front, and the numbers of the enemy with which that line will come in contact. For the actual contact, therefore, the attacking battalion would require all its men, and not only all its men, but all its men in close order; that is to say, all who may have survived to reach the enemy's position. The enemy's main position will no doubt—indeed, we may say certainly—be covered by strong skirmish line, and it appears to me that the main body of attack therefore must also be covered by skirmishers in the sense in which that term has always been understood. What formation that main body should assume in advancing to attack is the problem to be solved. The front of *attack* may be one thing; the front of *advance* may be another. The front of attack, by which I mean the front of actual collision, must be close; the front of advance, before coming into actual contact, may be open, the intervals being filled up by successive increments from the rear. But there are two points which are borne in upon me as being of great importance, which I venture to submit, Sir, to you and to this assembly, that whatever mode of advance we may adopt, if we adopt the open formation for advancing to attack an enemy's position, as it appears we must do, the feeding of the front of advance should always be directly from the rear; and that in no case ought troops, when under anything like an effective fire, to move to a flank, even for ten seconds, if it can possibly be avoided. I particularly allude to the description of what the Duke of Wurtemberg characterizes as the "concentric method of attack" in this pamphlet, which entirely fails to commend itself to my reason. I beg to submit those propositions to your consideration.

Major-General the Right Hon. Sir Percy Herbert, K.C.B.: As I understand General M'Dougall, he brings forward the battle of Gravelotte to illustrate the facility, not the difficulty, of a front attack. Now, I think the case tends exactly the other way. The enormous superiority of the Prussians on the occasion of the battle of Gravelotte has been entirely put on one side by my gallant friend. The superiority was very great indeed on that day. I do not allude to the battle of Vionville or Mars-la-Tour, where it was the reverse, but to the battle of Gravelotte proper. What was the crucial turning point of the battle? It was the second attack upon Marshal Canrobert's *corps d'armée.* The attack of the Guard at St. Privat was the greatest illustration that we have in modern times—I wont say of the impossibility—but the enormous difficulty of front attack over open ground upon troops that are prepared. When the Prussian Guard, in conjunction with other troops, renewed their front attack, what was the position of affairs?

1st. The German *corps d'armée* beyond St. Privat had developed their turning movement and flank attack against the French right.

2nd. The attack was upon Marshal Canrobert's corps. Now that corps was the last formed of the French Army. It was weak in men and incomplete in guns, having only 36 instead of about 80, and also in ammunition waggons.

It had been engaged many hours, and when the front attack was renewed, it was positively deficient of ammunition, and unable to keep up its infantry fire.

I say that that is a strong case in favour of the theory of the enormous difficulty anybody will have to contend against who attacks troops in open ground that are fairly prepared. Of course a case like that where the ammunition is exhausted in actual fight, is an exceptional case, and cannot be held to decide such a question.

Lieut.-Col. Owen, R.A.: The remarks I shall have to make will be simply confined to the Service to which I have the honour to belong. In the first place, with regard to massing guns, I have always supposed, till about a couple of years ago, it was pretty generally acknowledged that massing guns when possible, was the established principle. Just before the late war, we constantly heard the expression used by military critics in lecture rooms and in the newspapers, that "fire should be concentrated, but guns should not be concentrated." Now we all know that principle is very true as regards siege artillery or artillery for coast defence; but when you come to artillery in the field, I am very glad to hear the subject is well treated by Captain Brackenbury and to hear the reasons so clearly given why it is necessary, in order to keep proper control, and in order to preserve the common object, and owing to the extent of ground required by a large force of artillery, that the guns should be massed as we have seen done during the late and some former wars. There are one or two points upon which I have certainly not always followed the advocates of the Prussians in the employment of artillery. One is as to pushing forward artillery on the line of march. I have no doubt, as you want to produce an effect at the beginning of an engagement, that is the correct principle; but under some circumstances, as when armies are operating in close and difficult countries, it seems to me it would be a very dangerous proceeding to press forward very large numbers of carriages and artillery which are practically helpless on the march, and which might lead to great disaster. I think I am borne out in that view to a great extent by what Colonel Hamley says in the third edition of his book recently published. There is another point which I was glad to hear Captain Brackenbury mention, and that was, that although it is considered necessary to push forward artillery at the commencement of an action, still it is extremely desirable to keep a certain reserve of artillery for a decisive moment. We are all aware of many cases when such a reserve has proved of great benefit. For instance, take the battle of Lutzen, where the Prussians and Russians had over 400 guns. The French had more than 200 guns less; yet by a wise economy of artillery at the early part of the action, Napoleon managed at the decisive moment to bring this force into play, and with the assistance of it, prepared the way for the infantry who decided that battle. Many other instances will occur to most of your recollections. There is another point, and that is the formidable power of shrapnel. There is no doubt we have never yet seen what can be done by shrapnel fire from rifled guns in the field and under favourable circumstances. The fire of shrapnel was advocated some years ago before rifled guns were introduced—very strongly advocated by Major-General Boxer, and a great number of experiments were tried to compare the effects of shrapnel with those of round shot, projectiles now of course utterly discarded. With regard to the effect of shrapnel fired over troops, it must, however, be remembered we have several very great difficulties to contend with which, I think, do not apply to the use of common shell. In the first place, you are obliged to use shrapnel, necessarily a weak shell, with a large charge that gives the shell a high velocity, or the effect of the shrapnel is very little. That being the case, there is very great danger of either the fuse or the shell itself giving way. And besides that, supposing the fuse is not properly set, or the burst of a previous shell in the air not rightly judged, you may get premature explosion not at the muzzle but very short of the object. Now, premature explosion of a shrapnel shell from a rifled gun would be a much more formidable thing than it was even from a smooth-bore gun; and I think we may comfort ourselves as to what we have recently heard of the French guns firing with velocities of 2,000 feet a second; and be assured that we have nothing out of the common to fear from such guns in service in the field. If these velocities are attained, the practical use of shrapnel will be

almost impossible. Very few shells and fuses would stand the charges necessary to give these high velocities, and if we look at the gunnery point of the question, I cannot see myself that there is very great advantage in these high velocities for field guns, as, besides increasing the chances of accident to gun or projectile, they make the regulation of the fuses and the practice at troops behind cover more difficult. I can mention an instance of the fire of shrapnel over the heads of troops. During the attack on the Redan, General Bormann, the Belgian Officer, states that the Russians, who gallantly mounted the parapets, were mown down by the fire of shrapnel from the left attack by the naval brigade. Perhaps you would excuse my saying that I remember from the 5-gun battery (right attack) doing the same thing myself at the proper left flank of the Redan. We fired over the heads of the infantry that were assaulting, though certainly it was rather a dangerous thing to do. You must remember, however, that the flank of the Redan was 200 or 300 yards beyond the salient, and it was slightly to the right. I mention that to show that shrapnel might have to be fired over the heads of troops, but only with great care; and I wish to point out that as common shell are not liable to premature explosion, and need not be burst short of the object, they are therefore safer projectiles for firing over troops than shrapnel. One other point I should like to mention is,—the execution that may be done with common shell, fired, as they do on the continent, with reduced charges, which is of some importance. There are many circumstances in which troops would be as safe from fire with large charges as they would in this room. In the attack of troops behind good cover of villages, and so on, it would be a very great advantage to fire common shells with reduced charges. The Russian, Prussian, and other artilleries carry a certain number of reduced charges besides the ordinary charges; and I cannot help thinking it would be a wise thing for us to do the same, in order that we might have the opportunity of reaching troops sheltered from any other fire.

General Sir William Codrington, G.C.B.: I should wish in a few words, notwithstanding the presence of many artillery Officers, to refer to the infantry, which I consider the principal arm of the service. I will incidentally mention the firing over their heads in action. As Colonel Owen has said, if there is a failure of shrapnel which is said to be most destructive against an enemy, if there is failure of a fuze, it is a very serious thing for your own advancing troops. Whether artillery could get upon the flanks so as to keep clear as much as possible of the line of advance, is a point that must depend upon the nature of the ground. It is very convenient for artillery to take up a position, say 2,500 or 3,000 yards in the rear; but it is a very different question for the men whose heads are fired over. In action I believe it is the case, and those who have seen more service than myself will be able to confirm it, that, in the midst of the row you cannot tell where shot are coming from, and men who are being fired over may feel that the shot may just as well be coming from the enemy as from their own people, particularly if there is the slightest idea of the failure of a fuse in your own shrapnel. But the main point is the tactical question with regard to infantry. I have heard the expression used, of "an extremely rigid line." I do not know why a line is, because it is a line, to be so very rigid. The very nature of the ground—take even Aldershot or any country like Chobham, where there are hills—the very nature of the ground prevents it being what is called a rigid line. Nor do I understand what very material difference there is between the principle of a battalion having skirmishers in front, with supports in rear, and then a column in reserve, which was at that time out of fire, and the new or the Prussian line of advance. There are equally, in both cases, skirmishers; there are, equally, in both cases, supports; and equally, in both cases, there is a reserve. Before the war, we saw in the Prussian manœuvres an immense deal of column movement, which, certainly, was erroneous; and we have seen that, in the war, that column movement produced the frightful losses at St. Privat, and, I think, at other places. The result has been, that the Prussian system that was supposed to be so good before the war, was, after the experience of the war, entirely done away with as to columns under fire.

Now, a word about the skirmishing. My impression, having seen a certain number of the Prussian troops skirmish in peace, is that they advance in rather close order, that is to say, at about three paces distance. If the supports, viz., the com-

pany columns in rear, which are really the feeding supports, come up into the front line of attack, what is that but the concentration of a line for attack? It seems to me that the very object and purpose of having those reserves, is to make a concentrated effort by line, and to do what the English Service did before, namely, to attack in line. I do not mean to say the same line will go over the distance now under infantry fire that it could formerly; it would be absurd to suppose so, but for the last effort you will not get skirmishers to succeed against a position where there is shelter and solid defence. It is almost acknowledged that such a position is unassailable in front, and yet skirmishers are supposed to attack this body that is under shelter and concentrated, and are supposed to succeed as skirmishers. I do not see that this is likely to be the result until you have brought up the successive supports so as to fill the intervals between skirmishers, thus forming that line to which objection is taken, but which you certainly do want to make a concentrated attack upon a concentrated enemy. I should rather like the lecturer to explain any difference between the Prussian system and the English system in that respect, namely, when once the troops are in immediate contact with the enemy.

Lieut.-Gen. Sir Lintorn Simmons, K.C.B., R.E.: It appears to me there is a distinction without any very great difference on this question of line. Captain Brackenbury has explained that at the moment of contact with the enemy, the attacking body is in line, and, moreover, in tolerably close line; the great difference seems to be whether that line is to be formed at a distance and moved up as a line, or whether it shall be moved up in small units, taking advantage of all available cover till they come in contact with the enemy. Captain Brackenbury gave a most lucid explanation of the manner in which the Prussians advance by their company columns, which, according to his description, are not columns in the sense in which the term is ordinarily used in England; they are small bodies, which can be readily thrown into line, or into any other formation, so as to take advantage of any accidental cover they may find in their front. The consequence is, that a battalion, instead of advancing in a regularly formed line, with a front of 300 yards, is broken up into a number of units; the Prussians break it up into four, we break it up into eight; and those small units are under the immediate control of their respective commanders, and can be at once thrown into any formation that may be preferable, without reference to superior authority, but subject to the instructions they have received as to the object to be attained. For my own part, I do not believe it is possible, since the introduction of breechloaders and rifled artillery, to advance a battalion in line from the distance at which it is now necessary to deploy until it comes in contact with the enemy. With respect to artillery fire, I think the experience of the war of 1870 is very clear as to the possibility and absolute necessity of firing over troops. In the attack on Saint Privat, which has been referred to several times, the Guards advanced, covered by a line of skirmishers, to within 400 yards of the village, with their supports and reserves in column behind them; when the advance was checked, the whole body, including the skirmishers, lay down without retiring, and the artillery fire was continued over their heads until the attack was renewed, when the French artillery had retired. Whether these latter were obliged to retire in consequence of the effect of fire, or of failure of their ammunition, I do not know, but the 72 guns were withdrawn before the Guards resumed their attack. Then at Sedan we have a remarkable instance which illustrates the Prussian system of attack, as well as any example during the late war. The 19th brigade, 5th corps, attacked between Illy and Floing with four battalions, two in the first line, in their usual formation, and two in second line. These battalions advanced against the position occupied by the French over ground which was entirely exposed throughout the whole of the advance. They went into a valley, and by the time they got to a small brook which ran through it, the front line had absorbed the supports. They advanced up the hill by successive rushes for short distances, till at length it absorbed the reserve. There was a still fresh rush, and by the time they came in contact with the French, the whole four battalions were in one line; and that is precisely the line adopted by ourselves. The thin line in which the British Army has always fought, which is often regarded as our national formation for battle, and one which is calculated to draw forth the best qualities of our soldiers. It is the manner in which that line is to be brought to the front in contact with the

enemy that appears to me to be the question at issue. To follow up that attack, the Prussians failed; they fell back a short distance under cover. Immediately the guns behind at very considerable ranges, 2,000 to 2,500 yards, opened with immense effect on the French on the hill. The French, notwithstanding, came over the brow of the hill three successive times, to drive the Prussians down. The Prussians repulsed them, and eventually succeeded in gaining a house on the top of the hill, and then the hill itself was carried. That is a good illustration of the manner in which the line is formed by the successive absorption of the units in its rear. With regard to what dropped from my friend Colonel Owen, as to artillery being in front on the line of march preparatory to a battle, it appears to me that this is an essential at present. The advanced guard, or the troops whom you may call the escort or supports for the artillery, should no doubt be strong enough to secure the artillery from being surprised either in close or open ground. On coming in contact with the enemy, the artillery at once comes into position with as great force as can be collected at the time, the stronger the better. I think the whole experience of the war shows that the attack of infantry must be prepared by artillery, and therefore unless the artillery is well to the front, valuable time will be lost in the preparation for attack; time so lost on the part of the assailants is time gained on the part of the defenders, and will often enable them to bring up reserves and defeat attack, which should therefore be prepared and followed up with the greatest promptitude. There is one point in connection with the diagrams exhibited by Captain Brackenbury of great importance to which I would venture to allude. It appears to me that the two systems of attack there shown differ very materially in principle. In the one (Diagrams Nos. 9, 12, and 14) the front of command, including the supports and reserves, in contact with the enemy, is reduced to 137 yards. In the other (Diagrams Nos. 12 and 13) it is 875 yards. But, Sir, these are full-sized battalions, or battalions of something like 800 men, whereas battalions in the ordinary practice in field manœuvres are 300 or 400 strong—rarely more than 400. Now, it is a totally different thing to cover a front of battalions of 400 men each, with skirmishers, from what it is to cover a front of battalions of 800 each; and experience with the smaller battalions may lead to a faulty system of working with the larger battalions; in covering the front of 400 you reduce the front of command in immediate contact with the enemy by one-half, leaving the Commander a front of 438 yards to observe, whereas with large battalions, when a whole brigade is covered by a single battalion, he has a large front, and I question exceedingly whether any man in immediate contact with the enemy can possibly control a front of 875 yards. As to the observation that we must depend upon horses, I think it is very questionable, in fact, I doubt whether any mounted Officer would be able to remain for any length of time in close contact with the enemy. In the figure (Diagram No. 14) there is a system of support from front to rear by troops who work together under the same Commander. The support moves up, and is absorbed in the line of skirmishers, or extends that line to a flank, according to circumstances, trusting to the Officer commanding in the rear, who naturally looks after his own men and their safety, to supply its place, or if he finds them out-flanked, to save them by extending on the exposed flank; whereas, in the other case (Diagram No. 13), the reserves belong to other regiments, and there may be a hesitation on the part of the Commanding Officers to break up their battalions and let them out of hand for a purpose, the object of which is perhaps not clearly seen. There is, therefore, a very great advantage in one man having to look after a certain limited proportion of the field. High education in war training is absolutely necessary, high education not only of Officers but of men; it must commence with the soldier, then extend to the Non-commissioned Officer who commands a small section, and so on throughout the whole chain of command. A very high degree of training is absolutely necessary. I have only to say I think Captain Brackenbury has dealt with the whole subject so fully, that we owe him our very best thanks.

Major C. B. Brackenbury, R.A.: Concerning the vexed question of front attack of infantry upon infantry, I would remark, as I have seen it actually carried out very often in war, that the great difference in principle between the Prussian practice in combat and our system of line is in the extent of carrying out the law of respon-

sibility. In the Prussian practice the system of responsibility is carried down even so far as to a couple of men skirmishing together; they are responsible, not to any great degree, but for their own lives and for the lives of such men as are behind them. Those men so working attain by habit to such a condition of steadiness in warfare that I have seen them again and again lift up their rifles and take aim and, when their enemy moves, lower their rifle without firing. Each man learns to hide himself, to take care of himself, and mark his enemy. In our line the men can only hide by word of command, and they are hardly able to take aim at their enemy. Colonel Owen spoke against artillery being near the front on the march. Now it is very certain that artillery and infantry encumber each other on the march. Artillery walks slower than infantry does, but its slowest trot is faster than the quickest infantry walk; the two arms therefore incommode each other. The general idea now is that wherever it is possible the main bulk of the artillery should march on a road parallel to that of the infantry, escorted by cavalry; and this is more possible than is usually supposed, because there are now so many roads. The lecturer mentioned one question which has not been touched upon in the discussion, namely, whether artillery is able to withstand the attack of infantry. It may be improbable that artillery can advance against infantry, but I consider it quite certain that a well-served artillery properly supported will resist the attack of infantry. One battery of six guns might not, but it is a very different affair when there come to be fifty guns in line; the enormous amount of fire then developed enables the huge battery to defend itself. Heavier guns can be used now, and a longer range is practicable if you have heavier guns. I may mention one fact told me the other day in France, that when the troops entered Paris in the time of the Commune, the Communists fired at them from a range of 5,000 yards, with Reffye guns, and the slaughter in the Trocadero was so great that the troops were obliged to quit the place. To make proper use of long range we must of course have accurate aim. A great deal of the new tactics of artillery must depend upon the extent of the zone which the guns are able to command. In many cases the guns in the front line will assume the power formerly only possible to the guns which waited in reserve, that is to say, the power of defending the flanks against attack.

Note by Major C. B. Brackenbury.—As the time named by Prince Arthur for the duration of the discussion had already expired when I was called upon to speak, I felt constrained to curtail the remarks I should otherwise have made. With the permission of the Council, I will add something in the form of a note, especially as Captain Brackenbury left England immediately after the lecture.

1. There appears to be a common misunderstanding as to what is the substitute proposed for the English form of line by those who deny the adaptability of the old formation to modern requirements.

The advocates of a development maintain that the fire of modern weapons is so deadly that no troops in the world can retain any formation whatever under its effects at close range delivered by an enemy who is either lying down or covered by accidents of the ground. It is not merely that the courage of the troops fails, but that the formation is physically broken up by the fall of vast numbers *in an extremely short space of time.*

It is plain therefore that the inevitable break of formation must be met in some way. The only question is—How? It would be demoralizing to consider the first line beaten and send another to take its place, suffering of course exactly in the same manner.

It is proposed to recognize the fact that the troops which arrive within charging distance of the enemy must do so in *open order*, better surely so than in *broken ranks.* The proposal is simply this. Let the advanced troops in open order—call them skirmishers or what you will—be considered as the fighting line. Let them use all the ingenuity to be found among Officers and men in covering themselves during their advance and gaining what ground they can. They are never to fall back on supports nor to expect a body of troops to march up from behind for their protection. But they are to expect that every foot they win will be kept for them as they push on, and that their numbers will increase by a gradual process of feeding from

The CHAIRMAN: As our time is up, I propose that the discussion shall end. I only hope I may be allowed to thank those Officers who have spoken, for giving us their able speeches.

Captain BRACKENBURY: There are one or two points on which I think I am bound to speak. Lord de Ros seemed to think that I cast a doubt upon the ability of the younger officers of the British Army.

Lord DE ROS: Oh no!

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their friends in rear; and they are to be ready at any moment to seize a chance,—if the enemy is shaken or has his attention distracted by a flank attack,—a chance of rallying to any Officer who may call them and of charging home with a cheer.

If it be admitted that such a process or else failure must occur in war, it appears certain that it should be practised in peace, otherwise the men will feel confused by what will seem to them a fatal looseness. Hence arises the necessity for instituting a drill which shall teach steadiness in attacking upon the principles now stated,—principles not by any means adverse to that held by England when she set her lines against the Continental columns, but, on the contrary, natural growths from the root of the line idea. For the principle of the line was the development of a wide front of fire with comparatively slight exposure to the enemy's artillery. The system proposed carries these advantages a step further. The line required steadiness and discipline. The fighting open order line fed from the rear requires more steadiness and more discipline. Surely this ought to be no objection to Englishmen.

2. Artillery may hold its place against infantry, provided it have reason to expect succour in a short time and be not altogether unprovided with escort. Small broken bodies of infantry may indeed slip on unperceived, but can effect little against the great batteries which ought to be accumulated.

Infantry can kill men but cannot kill guns. Even one or two gunners left with a gun can work it, and have done so, in our service again and again. The fire of artillery has much more power of demoralizing the enemy than would appear from the number of men who fell killed or wounded under its effects.

When a number of guns support each other they give a flank as well front fire on every spot in front of them.

A cavalry escort will check infantry by merely showing itself when in combination with guns.

Limbers can generally be sheltered, or at the worst, if the horses face towards the rear, the limbers will act to great extent as shields for the animals from infantry fire. Why should not bullet-proof shutters be carried with the limbers to protect the horses?

3. There can be no place absolutely right in all cases for artillery on the march. Generally its most useful place will be in advance of all except the advanced guard and still more advanced cavalry. Sometimes, as in woods and defiles, when the enemy is at hand, it would be dangerous and useless to have the artillery in front. But those who, as a rule, fear for the guns if in advance, have hardly appreciated the value of the protecting cavalry veil which should always, when possible, float before the head of the columns.

4. Roads are now so many and so good, that artillery is easily moved in all civilized countries. Long range renders change of position less frequently necessary, therefore artillery horses are less constantly overworked in war, and may be kept in perfect condition. The use of heavier field guns is for these reasons quite practicable; but long range with powerful projectiles is useless without range-finders, which have not yet received the attention they deserve in this or any other country.

5. It was proved again and again in the late war that gray horses attract the attention of an enemy more than those of any other colour. Gray batteries invariably suffered much more than the others.

6. The old dispute between massing guns or concentrating the fire of separated batteries is held by all who have seen war on a modern scale as unpractical. So many guns are brought into action at once, sometimes before the infantry are engaged at all, that the only difficulty is how to find positions enough for them, whence a good view of the enemy can be obtained.—C. B. B.

Captain BRACKENBURY: Or rather that I think they are not fit for any position in which they may be placed. I am the son of an officer who fought as a subaltern in the Peninsula and was wounded as a subaltern at Talavera and Salamanca. I am myself only a captain, and not yet very old, so that I should certainly be fouling my own nest if I were to speak disparagingly of the younger Officers of the British Army. What I do say is this, and I hear it on every side, and I have heard it from the younger Officers of your Royal Highness's battalion, that they know that they have not got the fighting training they require. They do not learn for example how to attack an enemy in a wood, how to move to the attack on different natures of ground, and they crave and beseech to be taught.

Lord DE ROS: That is the ignorance which I denied.

Captain BRACKENBURY: I assure his Lordship that they admit it themselves. As to the question of firing over the head of infantry, if it were possible to avoid it, it would be most desirable to do so. There is always the risk of premature explosion, but when the whole front of the position becomes covered with infantry, there are only two choices open; one is, that the artillery advance in front of the infantry, which I think scarcely any one would desire, or else it must fire over the heads of its own troops, unless it ceases firing altogether. Sir Lintorn Simmons has fully answered the question put by Sir Wm. Codrington as to the system of attack which I advocate, and the system used by the Prussian army up to this time. The difference is simply this. The final rush, I perfectly admit, is, in either case, made by a line of troops, but the whole point is the way in which, in the first place, the troops are brought up to deliver the necessary fire which must demoralise the enemy before that rush can by any possibility be made. In the one case, the attempt is made to move up a battalion or a half battalion in line, as laid down in our new order; where it is said that the reserve half battalion, if there is a chance of advancing against the enemy, is to deploy into line, and to advance and pass through the skirmishers to attack a position which will even then be 300 yards off. They must thus advance in a line of half battalion over 1,000 yards. In the other case the shooting, fighting, skirmishing line, is fed by small bodies brought up in succession in extended order, and then there is only left the last 300 yards' rush for the reinforced flexible line, a line to all intents and purposes, when the last grand attack has to be made, and I believe that this advance can now only reap the fruits of the fire and cannot itself be the chief demoralizing element.

The CHAIRMAN: I am sure I am expressing the opinions of all here present in thanking Captain Brackenbury most sincerely for his able and excellent lecture on this very important subject,—a subject which, at this time of changes in drill and tactics, cannot fail to be of the deepest interest to soldiers of every branch of the Service. My friend, Captain Brackenbury, has had great opportunities of practically judging for himself the working of the different arms in the field, and we thank him most sincerely for having brought forward this subject in such an instructive manner.

Evening Meeting.

Monday, May 19th, 1873.

Rear-Admiral Sir ASTLEY COOPER KEY, K.C.B., President, Royal Naval College, Greenwich, in the Chair.

NAMES of MEMBERS who joined the Institution between the 15th and 19th May, 1873.

LIFE.

Brown, J. Clifton, Capt. Royal Lanc. Art. Mil.

ANNUAL.

Clarke, T. C., Captain R.E.
Loch, H. B., C.B., Lt.-Col., 2nd Cheshire Mil., and Lieut. Gov., Isle of Man.
Voyle, J. R. C., Lieutenant Bengal Staff Corps.

RIFLING FOR HEAVY GUNS.

By Captain J. P. Morgan, R.A., Assistant Superintendent Royal Gunpowder Factories.

The principles of rotation are very recondite, and have been the subject of some abstruse investigation; but it is not necessary to consider them mathematically, in order to understand their application to the rifling of guns.

They may be briefly stated as follows:—

In every rigid body there are "three principal axes," about which the body is capable of rotating permanently.

Two of these, the greatest and the least, are "stable axes of rotation," *i.e.*, if the body rotate round an axis having a very small inclination to either of these axes, it will continue to rotate without further divergence. The medium principal axis is an "unstable" axis of rotation, *i.e.*, if the body rotate round that axis exactly, it will continue to do so; but, if the axis of rotation be inclined to it in the very least, the inclination will become greater and greater. With these exceptions, the body will not rotate permanently round any axis, but, in all cases, the axis will change its position in the body until, at last, the rotation is round its shortest axis, which is the most stable of all.

When a body rotates round a stable axis, and is not acted upon by impressed forces, the axis of rotation not only retains its position in the body, but also in space, by always remaining parallel to itself. If, therefore, there was no resistance of the air to an elongated projectile after leaving a gun, the question would be very simple, for, all that would be necessary would be to give a comparatively feeble rotation round the longest axis, and the shot, by virtue of the rotation imparted, would go nearly point foremost for a considerable part of its trajectory. It would not, however, be possible to make the projectile strike point foremost at very long ranges *in vacuo*, and when we find, therefore, in practice, that it is possible to make rifled projectiles strike point foremost, even at very long ranges, we infer that this is due to the resistance of the air, and are led, not only to consider the causes which

produce this result, but *the simplest* method of obtaining it. It cannot be due, as some suppose, to the tendency of the projectile to take that position which gives least resistance, for then there would be no necessity to give any rifling at all. The laws which regulate the action of impressed forces on a rotating body have been pretty well determined, and, though they do not, owing to the difficulty of determining the resultant action of the resistance of the air, enable us to solve this question theoretically, they give great aid in drawing correct conclusions from observations derived from experiment. Whatever be the action of the resistance of the air, we know that it can be represented by two forces, one of which acts through the centre of gravity of the projectile and tends to produce a change in its velocity and direction, while the other tends to produce rotation round some axis, and thus tends to produce a change either in the direction of the axis or in the velocity of rotation, or both.

I shall consider more particularly the latter of these two forces.

It is a law in mechanics that, if a rotating body, whose axis and velocity of rotation are represented in direction and amount, by a straight line, be acted on by forces which would produce another rotation whose axis and velocity may be similarly represented by another straight line, the result is a rotation whose axis and velocity may be similarly represented by a straight line forming the diagonal of the parallelogram of which the two straight lines are the sides. All these lines pass through the centre of gravity of the body. If the axis of rotation be a stable axis, and the forces be gradually applied, the axis does not change its position in the body, but only in space, and the amount of change is proportional to the amount of force applied, compared with the force which would produce the original rotation.

This law may be illustrated by the gyroscope. If the gyroscope receive a rotation which to the spectator is seen to be in the direction of the hands of a clock, it may be represented by a straight line drawn in the direction of the axis towards the spectator. If now a weight be hung at the extremity of the axis towards the spectator, this tends to produce a rotation which may be represented by a straight line drawn from the gyroscope to the left, the result is, that the axis takes up a new position between the two, and moves to the left. If the weight be hung at the extremity of the axis from the spectator, the tendency to produce rotation will be represented by a line drawn to the right, and the axis will move to the right. So long as the weight is suspended, the deflection continues, and it ceases when the weight is removed. It will be observed that, when the rotation is considerable and the weight not too heavy, the deflection is almost exactly to the right or left; but, if the rotation be low or the weight considerable, there is also a tendency of the point of suspension to drop, so that, at each gyration, it descends lower and lower. I desire that this fact may be particularly borne in mind, as it explains why it is necessary to give a considerable rotation to rifled projectiles.

Another illustration may be given by the spinning of a top. The axis round which rotation is given is a principal axis, and thus there is no tendency to change its position in the top. If, when the point comes

down on the ground, the axis is vertical, the top will at once spin steadily on the ground. Usually, however, the axis is inclined to the horizontal, and the weight of the top, acting through its centre of gravity, tends to produce a rotation round an axis perpendicular to the axis of the top. The position of the axis thus changes; and at first the point describes large circles, rolling on the ground, the axis always being inclined inwards. When the point has become fixed in one place, the top describes complete gyrations. A peculiar motion is then observed, for the gyrations become smaller and smaller, until the top spins on a vertical axis or "sleeps" as it is called. This is due to the friction of the point on the ground, which a little consideration will show ought to produce this effect. As, however, the rotation becomes slower, the top begins again to gyrate, and, in spite of the friction on the ground, the gyrations become larger and larger, until the point begins to describe small circles on the ground, and the top wabbles. This last sort of motion very well represents the motion of a free rigid body rotating under the influence of impressed forces of comparable magnitude, and, as we shall see, has to be considered in the case of rifled projectiles as they move through the air.

The motion of the earth, which produces what is called the precession of the equinoxes, is another illustration of the same sort of motion. The shape of the earth is that of an oblate spheroid, and may be considered as a sphere enclosed in a hollow shell, which is thickest at the equator and tapers off towards the poles. The attraction of the sun on the sphere has no tendency to produce rotation; but, on the shell, the attraction of the sun is greater on the half nearer than on the half more remote. The resultant action is a tendency to draw the equator into the plane of the ecliptic, and produce a rotation round an axis perpendicular to that round which the earth rotates. The consequence is that the earth describes a huge gyration, once in about 25,000 years, similar to the top in its final stages, but in the opposite direction. For it will be observed that, whereas the weight of the top tends to increase the angle at the apex of the cone of gyration, the attraction of the sun on the earth tends to diminish it. And I should expect to find, also, if observations could be made for the gigantic period that would be necessary, that the obliquity of the ecliptic is gradually becoming less and less. It appears to me that to this cause is probably due the glacial periods which seem to have covered the whole surface of the globe, for, if the obliquity be becoming less, it must at one time have been greater than it now is; and, if the obliquity at one time has been very great, it would be sufficient to account for extreme heat and cold, every year, all over the globe. There is another action which, like the friction of the peg of the top, tends to retard the rotation of the earth, viz.: the friction of the tides, which Myer, in an elaborate calculation, has endeavoured to show is at present compensated for by the contraction of the bulk of the globe. The ultimate result must be, if sufficient time be allowed, that the earth will present only one side to the sun, a condition which we find in the case of the moon with regard to the earth, and, which Mr. Rigg has suggested to me, has been brought about by a similar cause. Doubtless, also, the fluid interior of the globe will

exercise a disturbing influence, and, considering that the laws which govern a fluid body in rotation under the influence of impressed forces differ in the results produced by them in the case of a rigid body, it has often occurred to me that the axes of rotation of the two are not coincident, but that there is a friction between the two surfaces which produces the magnetism of the earth, and also may be the cause of the periodic risings and subsidences of the crust of the globe so well known to geology, because thus the two equators would be continually altering their positions with regard to each other. The effect of the laws of rotation on the solid and fluid portions of the globe is an interesting speculation, but I should not care to carry it into the dark future, seeing that we are met with the prediction that our earth is not destined to last for ever. The three laws—heat, elasticity, and attraction of gravitation—were given to matter in the first three days of creation. The law of heat appears to be the only one which is fading away, but the promise is, "yet once again I shake the heavens and the earth," which not only appears to establish the undulatory theory of heat, but also may explain the other statement that the elements shall melt with fervent heat, or be dissipated by intense incandescence into space, possibly again, under the influence of these same laws, to form new worlds, in the way La Place has shown the universe to have been made.

Seeing therefore that the laws of rotation exist, not only in theory, but in undoubted fact, no explanation of the motion of a rifled projectile can be considered satisfactory which leaves them out of account.

If the shot come out of the gun perfectly centred, *i.e.*, rotating round its longest axis, and having that axis coincident with the line of flight, there will be no tendency either of the axis of rotation or of the projectile itself to deflect, so long as the motion is in a straight line, because the resistance of the air will act uniformly all round. As soon, however, as the trajectory has begun to curve downwards under the influence of gravity, the resistance of the air acts more on the under side than on the upper, and effects will be produced depending on the resultant direction of the resistance of the air in relation to the centre of gravity. If, as in the case of service projectiles, the resultant action be through a point of the axis in front of the centre of gravity, the shot will commence to gyrate in the same direction as a top; and, the resistance of the air, acting on the exposed side of the projectile, will cause it to be carried bodily from the trajectory in the direction of the deflection of the point; but, if the resultant act through a point behind the centre of gravity, as is supposed to be the case with cylindrical shot,* the gyration will be in the same direction as that of the earth, with a corresponding deflection of the shot. In both cases the tendency is to gyrate round the trajectory.

The rate of the gyration will depend on two things, viz.:—the amount of original rotation given to the shot, and the amount of force tending to produce a second rotation round an axis perpendicular to the first. If the amount of orginal rotation be low, the shot will begin to gyrate with a smaller deflection of axis than if the rotation be great. A low rotation,

* Proceedings O.S.C., 9th May, 1864, Minutes 11,804 and 11,805.

therefore, is to be preferred to a high rotation, as keeping the point closer to the trajectory. There are some causes, however, which interfere with the possibility of giving a very low rotation. In the case of the top, we have seen that, when the rotation is low, the gyrations become larger and larger. The same is to be observed in firing rifled service shot with too low rotations. They seem to go steadily at first, but afterwards begin to wabble as they proceed. In the case of the top, we saw that the friction of the peg on the ground tended to diminish the size of the gyrations, but, in the case both of cylindrical* and service shot, the friction of the air tends to increase their size, for, according to the principles investigated by Robins and Magnus, the rotating surface carries with it a current of air which meets the resistance of the air in different directions, and, the side of the head which leads the gyration and is rotating inwards, meets a greater resistance than the opposite side which is rotating outwards. In order, therefore, that the gyrations may not become too large before the end of the trajectory is reached, a sufficient amount of rotation must be given. The exact amount required is a matter well worthy of consideration, and varies in different guns, not only according to the length and diameter of the projectile, but also according to the amount of "centring" the shot has when it leaves the gun. With equal masses, the relative stabilities of shot varying in length, may be expressed inversely as the twist in calibres, but the longer projectile allows the resistance of the air to act with a greater leverage,† and increased rotation must be given to compensate for this. After the necessary allowance has been made for this, the main cause which prevents a very low rotation being given is, that a shot rarely ever leaves the gun exactly centred. If the shot come out not centred, but having an initial deflection of the axis, it at once commences to gyrate, and that too at the time when the resistance of the air is the greatest, so that when a properly centred projectile may be only at its first gyration, a projectile not properly centred may have reached its second or third, and that too under the adverse circumstances of increased resistance of the air which the other would have escaped. In order, therefore, to prevent the large gyrations being attained too soon, an increased rotation has to be given.

As an illustration of the effects of want of centring, I would offer the bad shooting of the original Lancaster gun. The outrageous

* Proceedings O.S.C., 19th September, 1862, Minute 7,381; and 8th May, 1863, Minute 9,015. The greater unsteadiness of cylindrical shot compared with service shot is probably caused by the fact that the flat head causes greater resistance of the air, and the friction acts at a greater leverage. This is not inconsistent with the supposition that cylindrical flat-headed shot deflect to the left, because, though the resultant action of the resistance of the air might act behind the centre of gravity, the action of the friction would probably still be felt most at the head, where the air was most, though uniformly, condensed all round. The true deflection of flat-headed projectiles cannot as yet be said to be satisfactorily determined.

† This greater leverage is, however, compensated by the smaller surface of the head which is exposed to the resistance of the air. It is probable, however, that the leverage increases more rapidly than the length of the shot. With the Snider bullet the resultant action of the resistance of the air must have acted very nearly through the centre of gravity, else the very low spin would not have been sufficient to insure the very tolerable accuracy of fire which has been obtained from it.

system of rifling, together with the badly fitting projectile which was adopted in this gun originally, made it an impossibility for the shot to come out properly centred. The consequence was that the practice made by it was very erratic, even with very high velocities, and the very considerable rotation which was given. The path of the projectile could be traced by the eye as it described a sort of spiral, sinuous, or corkscrew motion, at one time deflecting to the right and then to the left, and so on. Very much better shooting has been obtained from guns with one-third of the twist, and there can be no doubt that the reason is to be found in the fact that they delivered their projectiles better centred.

It is a curious fact that, with our service projectiles, the deflection is always to the right, and to this, no doubt, is due the accuracy of fire which is obtained by them; for, if at one time they should deflect to the right and at another to the left, it is scarcely possible to make accurate practice. A very crude theory, which I am sorry to say has found very considerable acceptance, has arisen from this fact. It is that "a shot " rotating rapidly and at the same time falling in the air, will expe- " rience a greater pressure underneath than above, and will, therefore, " roll, as it were, on the denser air below." That this cannot be the case is at once evident, when we remember that, according to the principles determined by Robins and Magnus in the case of round shot, it ought to produce a deflection in exactly the opposite direction, and, if it were the true reason, our service rifled shot ought to deflect to the left instead of to the right.

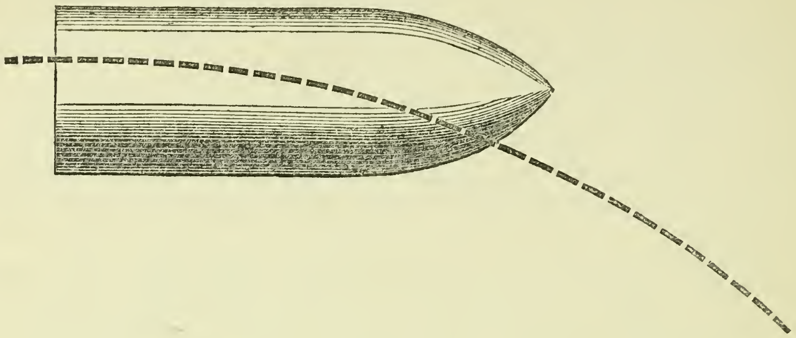
Professor Bashforth offers a better explanation in his valuable book on the "Motion of Projectiles," recently published. He says, p. 65, "The shot will have a sinuous motion. But as the *first* deflection of " an ogival-headed shot spinning with right-handed rotation is to the " right, and afterwards, as its point is directed more to the right than " to the left, the shot will have a deviation on the whole greater to the " right than to the left."

I have plotted some very accurate practice made with a B.L. 40-pounder Armstrong gun,* which is perhaps the most accurate shooting gun we have ever had in the service. This I did with the view of finding how the deflections varied. I found there was little or no deflection up to 700 or 800 yards. Then the deflection began to be appreciable, and increased up to about 1,200 yards, when the rate of deflection appeared to attain a maximum. After that, the rate of deflection to the right decreased, and I carefully watched to see if I could find any deflection in the opposite direction to the left, but I could trace none. From about 1,500 to 2,000 yards or more, there appeared to be very little tendency to deflect at all, but beyond that, the deflection to the right began to manifest itself, and at about 2,500 yards range it had again attained a maximum to the right, gradually after that diminishing, and, at more than 3,000 yards, showing some symptoms of deflection to the left.

It appears to me that the following diagram would very well repre-

* Proceedings O.S.C., 22nd October, 1862, Minute 7,634.

sent the deflection of the point in this instance, both in accordance with the facts observed and with the laws of rotation I have noticed.



The concentric circles represent the base of the shot, and the dark spiral line the supposed deflection of the point. The eye is supposed to be looking always in a line tangential to the trajectory. The dotted line is the course the point would take were the trajectory to be prolonged beyond the usual ranges, or which it would take were the shot

not properly centred. The reason of this somewhat curious, but very valuable, motion of the point appears to be due to the fact, that the dip of the trajectory materially interferes with the tendency to gyrate. As the point is gyrating downward the trajectory is also curving downwards, and it is the comparative rates of these two motions that produce the effects observed. At first the point will be dipping more rapidly than the trajectory, but, as the resistance of the air diminishes and the point comes closer to the trajectory, by virtue of the forward motion of the shot in the direction of the axis and the inward motion of the point due to the resistance of the air acting above the head, the dip will be less, and so the point does not get round below the trajectory at all. It will be observed that the first gyration is small, and, if we suppose it to occupy the time the shot would take to range 2,200 yards, the effect will be that the axis of the shot will coincide pretty closely with the trajectory for that distance. The second gyration is shown larger, because the resistance of the air has then become less, and the gyration will be made under a greater exposure of surface. This second gyration is therefore what we should have as the first gyration if we were to increase the spin, for the greater stability the shot would have, would cause it to wait until a greater amount of surface had been exposed before it would gyrate. It is important to notice this, because greater spin thus involves greater deflection of axis, and, consequently, greater resistance of the air; and that this

reasoning is sound is proved by the fact, that guns with a rapid twist, if they are accurate shooting guns, and do not deflect at one time to the right and at another to the left, as did the Lancaster gun, always deflect more to the right than those with a less twist.*

I have dwelt at some length on these principles because it is necessary to know exactly what we have got to do in rifling guns. It is a mistake to suppose that giving a very great twist is all that is required. What is required is to limit the extent of the gyrations as much as possible, so as to keep the point as close as may be to the trajectory, and thus insure less resistance of the air during the whole flight of the projectile and the greatest penetration at any point, and what is of still greater importance, to insure that the gyrations, whatever they may be, shall be regular, so that they may be allowed for and give accurate shooting. This last can only, it appears to me, be insured by proper centring; for if the projectile be not properly centred, there is always an initial cause to interfere with the after regularity of the deflection. There can be no doubt, however, that a rapid twist is the best thing that will compensate for want of centring, because, in the first place, it is not so easy to deflect the point of the shot as it comes out of the gun, when the twist is great; and, in the second place, any initial deflection which may exist becomes more readily absorbed in the larger and more stable gyration which afterwards ensues. It is better, however, to do with a less rapid twist and more perfect centring, not only because it strains the gun and the projectile less, but also because it in reality insures more accurate shooting.

No one will doubt the fact that some rifled guns shoot better than others, though some may be disposed to question whether the better shooting is due to more perfect centring. I may state therefore, in further support of the view here advocated, the results obtained in some experiments made with the Bashforth chronograph to determine the resistance of the air. This instrument gave a very accurate measurement of the resistance of the air, both with round shot and rifled projectiles. With rifled projectiles, the resistances were found to vary to a much greater extent than with round shot, and it is reasonable to suppose that where the resistance of the air was least, the projectiles were best centred, and less perfectly centred, when the resistance of the

* The following table, taken from "Reports of Experiments with the Bashforth Chronograph," shows the co-efficients of the resistance of the air with Whitworth and Service projectiles, page 168 :—

Velocity.	Whitworth Flat-headed shot.	Ogival Radius = $1\frac{1}{2}$ diameter.	Hemispherical head.	Spherical shot.
f. s.				
1140	·0001396	·0001079	·0001329	·0001534
1060	·0001246	·0000972	——	·0001473
928	·0001384	·0000659	——	·0001385

This shows that, with Whitworth shot, the co-efficient of resistance does not decrease with the velocity of translation in the same manner as Service rifled and spherical shot. I have no doubt that the greater spin with Whitworth shot is the cause of this, as explained in the text.

air was greatest. Great differences were sometimes found in this respect, and it was a rule that when the resistance of the air was great, the accuracy was not so good, and *vice versâ*. One gun, a long B.L. 40 pr., converted into a M.L. 47-pr., was remarkable both for the small amount of resistance it gave and for its great accuracy of fire. No difficulty was found in firing through 10 screens with it without mishap, and it could be fired with accuracy at lower velocities than any of the other guns. The regularity of the resistance of the air was also very remarkable as compared with the other guns.

If the shot came out of the gun without any deflection of the axis, but rotating round an axis inclined to the longest axis, it would be sufficient to account for the increased resistance of the air. For many reasons I am not disposed to think that this is ever the case. It would not account for the generally inferior shooting which was found with increased resistance, and I cannot see how the small amount of play the projectile has in the bore of the gun, would be sufficient to allow for the great differences in resistance which were found to exist, sometimes as much as 25 or 30 per cent., or even more.

The question arises, how can we suppose a sufficient amount of initial deflection to account for so great an amount of increased resistance, but it will be admitted that there are various causes which will account for this. If the shot be knocking itself against the bore as it moves on, it may have a final knock as it leaves the gun which will have the effect of deflecting the axis sufficiently to account for the differences observed.

It is possible that such a knock might be sufficient to upset the stability of the axis, and cause rotation round an axis inclined to the longest, and I am aware that some people hold this view, and think that it accounts for a very curious fact which has been observed in the penetration of iron plates. On this supposition the shot comes out of the gun rotating round an axis inclined to the longest axis, and thus at short ranges the amount of surface presented is greater than at longer ranges, when the shot, by virtue of the stability of its axis, has had time to centre itself.* I would offer a suggestion however which, it appears to me, would account for this fact without supposing that the stability of the axis is upset. It is this. At the moment the shot is leaving the gun, we may suppose that it is rubbing along the bottom of the bore, and that the gas is rushing over the base of the shot. As soon as the lower part of the base is unsupported, the effect of the gas pressing downwards will be sufficient to give a considerable initial deflection of the point to the right. At first, therefore, the point of the shot will not be in the best position for penetration, but, as it proceeds, the point will dip and will not only conform more to the trajectory but also to the face of the target, which generally has a slight inclination backwards. It seems to me that this action of the

* General Mayevski supposes another sort of centring action different from this, and probably the same as that given in the text where the curve of the trajectory interferes with the gyration, and at one point brings about a close coincidence between the axis of the projectile and the trajectory. This is not, however, what is here referred to.

gas would not be sufficient to upset the stability of the axis, because it is familiar to everyone, from the noise that a rifled shot makes on ricocheting, that the stability of the axis is not upset, but only that the point is very much deflected, which causes the regular roaring noise which is heard, each gyration being distinctly traced by the ear. Now, if the severe blow on striking the ground, which causes so great a deflection of the point is not sufficient to upset the stability of the axis, I do not see how the lesser blow of the gas on the base of the shot, which produces a much smaller deflection, will be sufficient to do so.

This view is strictly in accordance with the fact that the best remedy for want of centring, is to be found in a long gun. All our longest rifled guns shoot best, and, if what I have stated be correct, it is to be expected that they should do so, for the longer the gun, the less will be the stress of the gas as the shot leaves the muzzle, and the less will be the knocking, if any, against the sides.

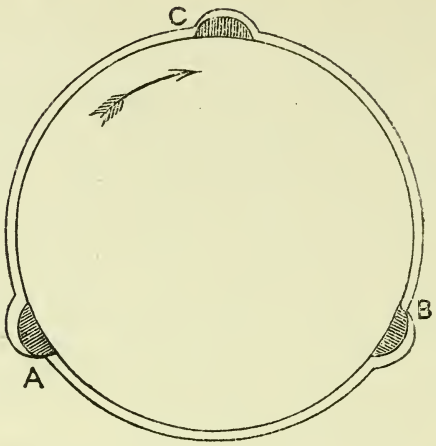
It was found in the Bashforth experiments, that the 9-inch gun gave less resistance of the air when fired with 36 lbs. of R.L.G., than with 43 lbs. This appears to support the idea. Practically, it was found that, though 43 lbs. gave 40 feet more velocity than 36 lbs., yet the latter charge would have a greater striking effect at 2,000 yards.

Too much attention has, I think, been given to centring in the bore of the gun itself. What is wanted, is that the projectile shall be centred as it leaves the gun. It may be centred all along the bore of the gun, but, if it receives a blow from the gas as it leaves the gun, all the advantage will be thrown away. If by centring in the bore, any knocking against the sides can be mitigated, this will undoubtedly be an advantage. We ought, however, to take a lesson from the results of experience, and I think it will generally be admitted, that a long gun is the best method of insuring accurate centring and consequently accurate shooting.

A great many methods have been tried, with the view of securing accurate centring. The first and perhaps the best, was Sir William Armstrong's system of lead-coating. The shot was kept jammed in the bore through its whole length and could not possibly wabble about. His shunt gun also provided for centring as the shot left the muzzle, by shallowing the grooves just before the shot effected its passage out of the bore. Sir Joseph Whitworth tries to get centring by making his shot as near as possible a mechanical fit, with a considerable amount of success. I have no doubt, however, that his taper base has something to do with the accuracy of shooting he has attained, for it will allow the gas to act more uniformly round the base of the shot as it leaves the gun. This taper base, however, involves a semi-flat head, so as to avoid too great deflection ; but the greater resistance of the air which accompanies this is objectionable, and should be avoided if possible.

Another method, which has found many advocates, consists in making the shot centre itself. The principle, on which this depends, was first explained to me by the late Major Haig, R.A., one of the most scientific Officers the Royal Artillery has had in recent times, but I am sorry to say has now lost.

It is as follows :—



Suppose a shot, moving along the bore of the gun, is compelled to rotate as shown by the arrow by the bearings at the points A, B, and C, then, by virtue of its inertia, it will assume a position where the rotation is least; and this can only be in the centre of the bore, for, it will be observed, that, if it goes to one side, the bottom for instance, it can only do so by taking more rotation, pivoting round the point A. Rather than do this, it will centre itself in the bore of the gun. Captain Scott, R.N., claims this as an advantage, with his system of rifling, which consists of long iron ribs on the shot, giving a sufficient amount of bearing surface to prevent any wear of the ribs, which would of course, interfere with the perfect action of this principle.

The Woolwich system is well known, and practically consists in giving rotation by a single row of soft studs all round the projectile, so as to allow of an increasing twist being given to the grooves of the gun, and thus reduce the maximum strain caused in giving rotation, both on the studs and gun. The small amount of windage given between the shot and the bore, is considered sufficient to give accurate centring. The windage over the studs also, is less than over the body of the projectile, so that the soft metal studs receive any side blow which may be given to the bore of the gun, and thus diminish any knocking action that may exist.

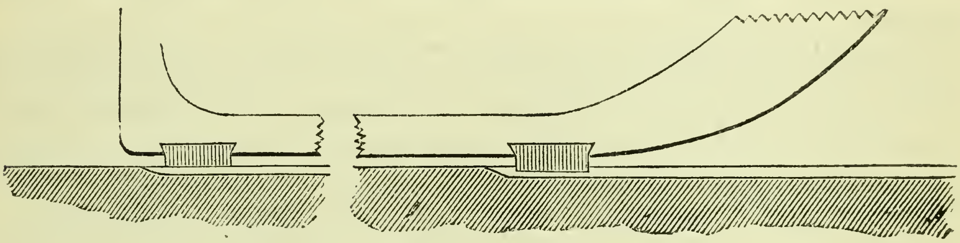
These are all the systems which have been tried in this country, which have given results entitling them to be considered applicable to heavy guns; but there are two others I may mention, which have been adopted or tried by foreign Governments, which I think worthy of consideration.

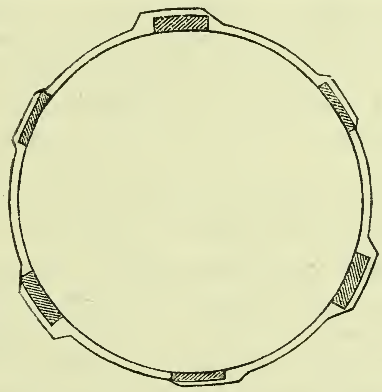
The Austrian Government tried a very long B.L. Gun, which fired lead-coated projectiles, but which differed from the Armstrong, not only in the breech-loading action, but also in the grooving of the gun. The number of grooves was reduced to one-half, and the grooves were made very wide, while the lands were very narrow, so that, practically, the lands cut readily into the lead-coating, and thus diminished the friction, while the power to produce rotation was not reduced, but

rather increased, for, it will be admitted that, as the lead-coating is much softer than the steel land which cuts into it, the strength of the lead-coating will be increased in this manner, while the steel land will have sufficient strength.

The other system I wish to mention is that adopted by the Norwegian Government. It has an uniform twist and has one row of studs all round the projectile towards the front, to produce rotation, and another towards the base to give centring. These two sets of studs have separate grooves.* The driving grooves are deep, but terminate at some distance from the powder-chamber. The steadying grooves are shallow, and are carried up to the powder-chamber. The studs are not rounded off but are purposely left angular, so that, by the first wear of the driving studs, the projectile may come gradually into bearing, and also allow the steadying studs to leave their grooves and jam themselves tightly in the bore of the gun.†

The following wood-cut shows the grooves and studs with their 3-pounder mountain steel gun:—





A great many points of considerable importance must be borne in mind, in considering the value of these different systems of rifling.

* In the smaller guns only. In the larger guns the driving and steadying studs are in the same groove, and a similar action is obtained by sloping away the driving edges of the driving-studs.

† I am persuaded that some sort of action as this exists in the Woolwich gun, for it will be observed in the recovered projectiles that, in some cases, nearly one-half of the studs are worn away. Thus one half of each stud may give rotation, and the other half centring.

The first, and not the least, is the effects they have on the strength of the gun. Those which cut deep grooves are most detrimental in this respect, and thus far the Austrian experimental gun has an undoubted superiority, for, not only are the grooves shallow, but, what is of much more importance, they are many and broad. One groove in the bore of a gun injures the gun much more than fifty; for, we must not only provide for the strength, but also for the stretch of the bore. If there be only one groove, the whole stretch tends to come on that part, because it is weakest and yields most readily. It is the same principle, which has been successfully avoided by Sir William Palliser, in making the body of his bolts less in diameter than the weakest parts of the thread, so that the stretch comes on the body which is long rather than on the shallow part of the threads, which are comparatively very short. The defect of this law was also discovered and early avoided in the Royal Gun Factories, by not cutting the thread for the breech-screw deeper into the breech-piece than that part which received the steel tube. No other system avoids this objection, for we find they all cut grooves into the bore of the gun and thus injure it more or less. Even Whitworth's hexagonal system of rifling is a grooved system in this respect.

Those systems which have most grooves are, however, to be preferred to those which have fewer, and the fact that the Norwegian system has a double number of grooves is rather an advantage than a disadvantage, and so I have heard it claimed by an intelligent Officer of that country.

In connection with the effect any system of rifling has on the strength of the gun, a most material point is the windage given. From my experience of the nature of powder hitherto manufactured for heavy guns, I consider it very advisable that some windage should be allowed to act as a safety valve after a certain point. A very small increase of the amount of powder consumed, causes a very great increment of pressure; and a very small amount of windage gives a corresponding relief. This is a very difficult problem, for windage is also the main cause of the scoring and destruction of the guns at present in the service. The only escape out of the two objections, that I can see, is to stop the windage over the body and give it through the interior of the projectile, utilizing it at the same time to ignite the fuze. Lead-coating effectually stops windage, advantageously or disadvantageously, and in this respect is superior or inferior to all the others, according to the circumstances of the case. I believe, however, it is possible to stop windage in all guns by the use of an expanding wad, which would thus render them all practically equal in this respect.

It remains now to consider the strain and friction on the surface of the projectile, and on the grooves of the gun. The easiest way of doing this is to compare the amount of force required to produce rotation with that to produce translation, and also the friction of the shot along the bore.

Let x = the distance travelled by the shot in the time t.
θ = the angle of rotation described in the same time.
P = pressure producing translation.
p = do. do. rotation.

Then in a cylinder of r = radius, and M = mass, for one turn in n calibres.

$$x = nr\frac{\theta}{\pi}$$

$$\frac{d^2x}{dt^2} = \frac{nr}{\pi}\frac{d^2\theta}{dt^2}$$

$$\text{but } \frac{d^2\theta}{dt^2} = \frac{pr}{M\frac{r^2}{2}} = \frac{2p}{Mr}$$

$$\text{and } \frac{d^2x}{dt^2} = \frac{P}{M}$$

$$\therefore \frac{P}{M} = \frac{nr}{\pi} \times \frac{2p}{Mr}$$

$$\text{and } P = \frac{2np}{\pi}$$

$$= 25p \text{ if } n = 40.$$

Thus, with an uniform twist of 1 turn in 40 calibres, the force producing rotation at the surface of the shot is 4 per cent. of the total pressure of the gas at any moment on the base of the shot. The useful effect of the force of translation absorbed is, however, the resolved part of this along the bore, or about $\frac{1}{13}$ of 4 per cent.—*i.e.*, $\frac{1}{3}$ per cent. nearly. The friction, however, has to be added to this, which, supposing it to be $\frac{1}{4}$ of the pressure, gives 1 per cent. in addition, thus using altogether $1\frac{1}{3}$ per cent. of the force of translation. Thus with a 600-lbs. shot in a 12-inch bore, with 20 tons per square inch of maximum pressure of powder, the pressure producing rotation would be 90 tons; with a 15-inch gun and 1,200-lbs. shot and 25 tons pressure it would be 180 tons. If we suppose excessive pressures, as often occur in the bores, of twice or thrice the amount supposed, these pressures will be doubled or trebled.

The effect of the increasing twist is to make the amount of pressure depend, not on the amount of maximum pressure of the powder, but on the amount of rotation to be produced, distributing the pressure more uniformly along the whole bore of the gun, and making it less as the length of the gun is increased. With the length in use with our service guns, and with the twist used in the 10-inch gun, from 1 turn in 100 to 1 in 40 calibres, it has been shown by Captain Noble,* late R.A., now of Elswick, that the pressure is uniformly distributed, with the pressures found by the Committee of Explosives to exist in that gun, and does not exceed $\frac{1}{2}$ of what it would be if the twist were uniform. If, however, the initial pressure in the bore were doubled or trebled, there would also be a maximum pressure double or treble the amount calculated.† The twist

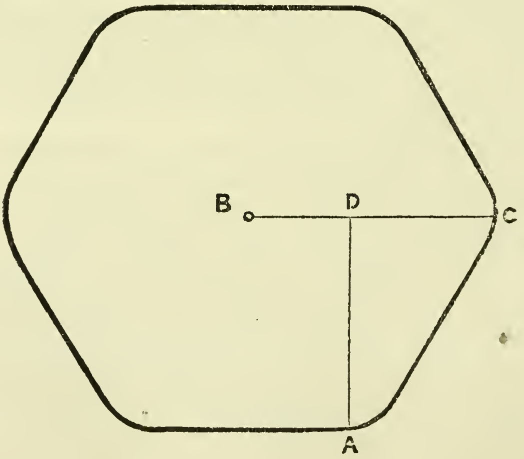
* "On the pressure required to give rotation to Rifled Projectiles," by Captain Noble, F.R.S., &c., late Royal Artillery. *Philosophical Magazine* for March, 1873.

† Captain Noble takes no account of these very high pressures in his calculation. They ought not, however to be omitted in the consideration of the proper rifling of

increasing from 0 to 1 in 40 would have the effect of giving a greater pressure towards the muzzle of the gun than one from 1 in 100 to 1 in 40, but it would have the advantage of having no maximum pressure at the commencement of motion, when the initial pressure on the base of the shot was doubled or trebled. The practical result, therefore, of an increasing spiral is that, with a good uniform powder, it is about $\frac{2}{3}$ that of an uniform twist, but with a maximum pressure of twice or thrice the legitimate pressure in the powder-chamber, it will reduce it to $\frac{1}{3}$ or $\frac{2}{9}$ of what an uniform twist would give under similar circumstances.

In order, therefore, to provide against all possible contingencies, an uniform twist ought to have 4 times the strength of studs or ribs to be as safe as one increasing from 0 to the same amount of twist with guns of the service length. If, therefore, an uniform twist has 4 times the bearing surface as an increasing twist, it is practically as safe. Comparing, therefore, Captain Scott's system with the Woolwich on this subject, I am compelled to admit that it is quite as safe, and, indeed, very much safer, for it has much more than 4 times the bearing surface.

The shunt system has nearly, perhaps not quite, 4 times the bearing surface, and, I doubt not, would be quite strong enough. The Whitworth gun has much more than 4 times the bearing surface. The pressure which produces rotation, however, by no means acts at the extremity of the radius of the projectile, but at between $\frac{1}{2}$ and $\frac{1}{3}$ that distance, as will be observed by the accompanying woodcut, where the pressure at A, the driving edge of the groove, acting normally to the surfaces, has a direction, A D, which practically makes B D less than one-half the radius, B C.



our heaviest guns, in which they are found to a very great extent. It is because they exist that the increasing twist from 0 to 1 in 40 is superior to one from 1 in 100 to 1 in 40; and I have no doubt that it is for this reason that the latter twist has been abandoned in favour of the former. The 10-inch gun has a twist from 1 in 100 to 1 in 40, and it will be observed that projectiles fired from this gun have the studs very much worn. It is worthy of remark, that both the 10-inch and 35-ton guns shoot remarkably well; the latter gun has a twist commencing from 0.

Taking a 600-pounder gun and high pressures, we should, under the same conditions as before, have about 700 tons producing rotation, which would be more than 100 tons on each edge; and, if we suppose the driving edge to be 1 inch wide* and 20 inches long, it would, with 1 turn in 40 calibres, give a pressure of 5 tons per square inch, which, on the great amount of surface employed, must produce enormous friction. With a 1,200-pounder it would be worse and worse; about 8 tons per square inch on a still greater surface. Still worse, however, Whitworth's small bore necessitates a twist of 1 turn in 20 calibres, so that these pressures, great as they are, would have to be doubled. It is difficult to estimate the amount of longitudinal pressure that would thus be consumed, the co-efficient of friction with such high pressures being very great: probably it would not be less than 10 per cent.

Captain Scott's system, having less bearing surface, but acting at the end of the radius, will probably, with the same twist and number of grooves,† have about the same amount of pressure per square inch as Whitworth's system, but will impede the velocity of the projectile less, owing to the smaller amount of surface under friction. The number of his grooves, however, can be increased to any amount, and thus the friction can be reduced to any extent desirable, a point of very great importance, as there is a limit, by the laws of practical mechanics, to the amount of pressure which should be given between surfaces in contact—700 lbs. per square inch.

With lead-coated projectiles, the whole surface would probably be under the action of friction to produce rotation, but, owing to the softness of the lead, and the difficulty of securing its proper adhesion to the body of the shot, I should be afraid to form any estimate of its value with very heavy guns. The longitudinal friction of the lead-coating in the bore is enormous, wasting on an average with very heavy guns about 10 per cent. of the useful effect of the gas—no other system, except Whitworth's, wasting nearly the same amount of the longitudinal pressure forward.

The Norwegian system is less capable of giving effective rotation. They could, however, easily increase the number of their driving studs. But, instead of doing this, they diminish the rotation, giving only one turn in 55 calibres; and with their large bores and tolerable centring they, I am told, get very good shooting.

Excepting, perhaps, lead-coated projectiles, the Woolwich studs are

* Whitworth claims a greater breadth of bearing surface than is here stated, but it is questionable if he gets more, because the pressure is obtained by the yielding of the metal to some extent, and this can scarcely be allowed for. Besides, any additional surface brought into play will act at shorter radius, and produce less proportionate effect in giving rotation, but more in giving friction. I think I have stated the case very fairly.

† The grooves, however, are here supposed to be deeper than those used by Captain Scott in his guns of smaller calibre, which are only ·125 inch deep. It is not necessary to consider the depth of Captain Scott's grooves an essential element of his system any more than the number. As the number increases, so may the depth without detriment. Whitworth, however, cannot increase the number of his grooves.

strained most severely, and I doubt not are often subjected to a strain of 20 tons per square inch, causing the studs to bulge. With proof cylinders an extra stud has been inserted in each longitudinal row, which materially increases the strength. The studs, however, are very much worn by the great friction, which must necessarily cause a greater waste of longitudinal pressure than if so much wear did not take place, as well as try severely the driving edge of the grooves.

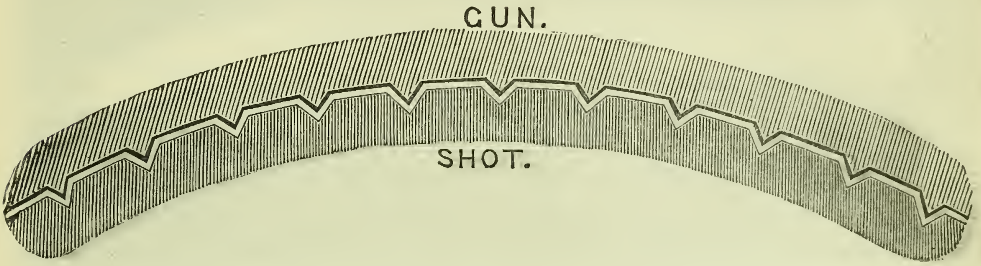
I have said nothing on the relative merits as regards centring by these systems of rifling, because I can scarcely offer an opinion. The best way of testing them on this point would be to fire through a number of paper screens at different distances so as to trace the trajectory, using at the same time the Bashforth chronograph to obtain the resistance of the air. The latter would give the amount of deflection of the point of the projectile, and the former the direction of the deflection.

I trust you will agree with me that I have done right in not speaking in terms of highest praise of any one of the systems of rifling which I have reviewed. I cannot assign the palm of undoubted superiority to any over all the others; each has its advantages and its disadvantages, and none are without objections. This is generally admitted, and has come to be thought a necessary part of all rifling. I am not, however, of that opinion, and shall now present you with what I have but recently come to consider a system which has all the advantages and none of the disadvantages of the systems I have noticed.

It may be briefly stated thus. Adopt the system of grooving in the Austrian B.L. experimental gun, but do not adopt the lead-coated projectiles. The lead-coated projectiles, in addition to the disadvantages I have pointed out, have the serious disadvantage, mentioned by Colonel Reilly, R.A.,* of being less effective against armour plates than iron projectiles, because the lead flies off on impact and does not help the projectile through the target. But, if we groove the projectiles so as to fit the projecting ribs of the gun, we do away with this objection, and we get an amount of bearing surface which alone meets the mechanical requirements of the case. I have adopted here 64 grooves in the shot, and the same number of lands in the gun, and, if we suppose them ·3 inch deep, we have an amount of bearing surface, which, under ordinary pressures, in a 15-inch gun, with a projectile of 1,200 lbs., and a twist of one turn in 40 calibres, would reduce the

* Notes of a visit to Berlin, December, 1872, by Lieutenant-Colonel E. Reilly, C.B., Assistant Director of Artillery, page 20 :—" This lead covering causes a great " waste of power, as it is the iron part alone of the shell that can do work against " the iron plates, and consequently a considerable force is expended in projecting a " part of the projectile which is useless for the work which has to be performed." On this point Mr. Krupp remarks (letter 16th February, 1870), that the experiments at Tegel, 4th August, 1868, " again demonstrate that, in the case of the breech- " loading projectiles, a heavy lead-coating can so weaken the effect as to render it " insufficient." And Captain von Doppelmair, a strong advocate of Mr. Krupp, says, " We shall not be much in error when calculating the momentum of a lead- " coated shot if we only take into account the weights of the cast-iron or steel core " (pamphlet).

pressure below 700 lbs.* per square inch, the mechanical limit of pressure between surfaces in contact under friction. Here then is a perfect system of giving rotation. It does not cut into the bore of the gun, and therefore does not weaken it. And it will not wear the grooves, nor waste more than probably one-half of a per cent. of the longitudinal pressure of the gas, because with the small amount of pressure between the ribs and grooves, lubrication may be used. Practically, so far as rifling is concerned, both gun and projectile are everlasting.

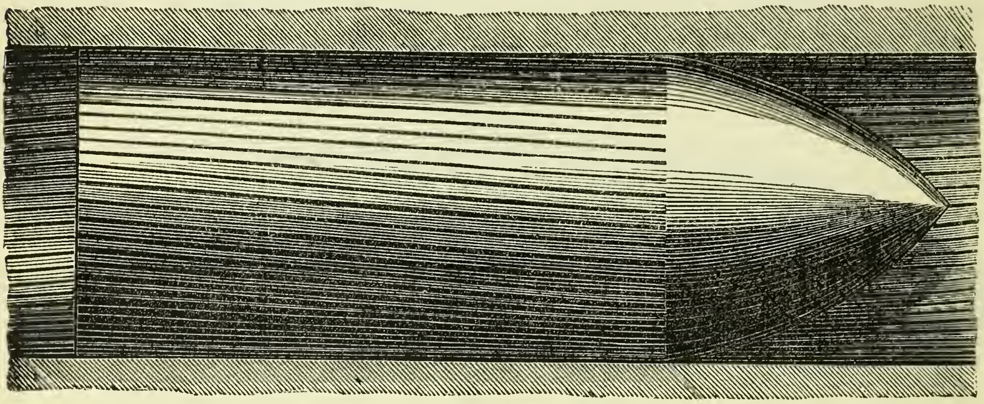


The following Table will serve for comparison of the probable pressures which produce rotation, and are wasted in friction, with the various systems of rifling. They are all calculated for a twist of 1 turn in 40 calibres, so that those given with Whitworth's rifling would have to be doubled for 1 turn in 20 calibres adopted by him. The pressures in *italics* are those due to exceptionally high pressures.

Systems of rifling.	600-pr. gun.				1,200-pr. gun.			
	Bearing surface inches.	Pressure on studs. Per sq. in. tons.	Pressure on studs. Total tons.	Longitudinal pressure wasted per cent.	Bearing surface inches.	Pressure on studs. Per sq. in. tons.	Pressure on studs. Total tons.	Longitudinal pressure wasted per cent.
Woolwich uniform twist	5	18	90	$1\frac{1}{2}$	7	26	180	$1\frac{3}{4}$
Woolwich "	*5*	*45*	*225*	*2*	*7*	*65*	*450*	*2*
Woolwich 1 in 100 to 1 in 40	3	15	45	$1\frac{1}{2}$	4	23	90	$1\frac{3}{4}$
Woolwich "	*3*	*37*	*111*	*2*	*4*	*58*	*225*	*2*
Woolwich 0 to 1 in 40 ..	3	20	60	$1\frac{1}{2}$	4	30	120	$1\frac{3}{4}$
"	*3*	*20*	*60*	$\mathit{1\frac{1}{2}}$	*4*	*30*	*120*	$\mathit{1\frac{3}{4}}$
Whitworth hexagonal ..	120	2	240	4	170	3	480	$4\frac{1}{2}$
" ..	*120*	*5*	*600*	*5*	*170*	$7\frac{1}{2}$	*1,200*	$5\frac{1}{2}$
Scott	45	2	90	$1\frac{1}{3}$	60	3	180	$1\frac{1}{2}$
"	*45*	*5*	*225*	$\mathit{1\frac{1}{2}}$	*60*	$7\frac{1}{2}$	*450*	*2*
Lead-coating	—	—	—	10	—	—	—	10
"	—	—	—	—	—	—	—	—
Proposed rifling	240	$\frac{1}{3}$	90	$\frac{1}{2}$	540	$\frac{1}{3}$	180	$\frac{1}{2}$
"	*240*	$\frac{5}{6}$	*225*	*1*	*540*	*1*	*450*	*1*

* This is for ordinary pressures. With exceptional pressures, the same as in the other calculations, the maximum would be about one ton per square inch.

There are some other points which I may consider more in detail. It may be thought that the expense of cutting so great a number of grooves in each shot will be considerable, but I am assured, by a very able practical engineer and mechanic,* that this would not be the case, for a machine could easily be constructed which would cut them all in one operation.



But how about chilled projectiles? They can be turned and grooved, though it is more expensive to do so than with ordinary cast iron. I should, however, prefer to cast the shot in a cylinder of cast or wrought iron, and groove the outer casing thus formed. A wrought iron casing would be a very great advantage, because on striking an iron plate, the tendency of the body of the shot is to split in two, and fly forward like lead-coating, while the head jams in between the two pieces, but a wrought iron casing would prevent this.†

Another great advantage is that it could be used with breech-loading as well as with muzzle-loading guns. It is by no means an easy problem to solve how we are to secure that the projectile shall occupy its proper seat if we do away with lead-coating, because any arrangements made when the gun was new, might fail if the bore was worn out by scoring. It would be very easy to stop this scoring on this plan, by a wad, for the sharp edges of the ribs would readily cut into the wad and preserve the bore, or at all events the ribs themselves, from being eaten away. All

* On this point, Dr. Anderson, Superintendent of Machinery, War Department, observes in a letter to me, 12th May, 1873, "If the projectiles were to be done in "large numbers, so as to make it worth while to provide self-acting tools to act with a "number of cutting instruments simultaneously, the cost for wages would be very "trifling, requiring one quarter of an hour of unskilled labour. Of course, the size "would have an influence, but the cost would not be any barrier to the system if it "is right in other respects."

† Captain C. Orde Browne, late R.A., and Captain Instructor Royal Laboratory, in Proceedings, Royal Artillery Institution, vol. vii, page 25, says:—"The pro-"jectiles cast with sand bodies are superior in penetration to those entirely chilled; "because, as may be seen, while the pressure round the head towards a centre does "not test its tenacity, the base is in a very different condition. The metal then "having lent its force to some extent to the head, shivers away to the front, gene-"rally indenting the plate round the hole made by the head. Any increase of "tenacity in the material at the base is therefore clearly an advantage."

that would have to be done would, therefore, be to insert a few small zinc studs in a few of the grooves, and allow the projectile to go up until these studs come up to where the ribs terminated beyond the powder chamber. These zinc studs would probably afterwards aid the centring. The bore would thus not only not be weakened as in nearly every other system by narrow deep grooves cut in the most vital part of the gun, but would not wear out by scoring, and I have no doubt, if combined with the gun I had the honour to bring forward in this Institution three years ago,* that the endurance of our heaviest guns might be extended to 10,000 or 20,000 rounds. The use of a wad would not only stop the scoring but might also materially improve the accuracy of practice, if it prevented any rush of gas over the base of the projectile to produce initial deflection as the shot left the gun. With a breech-loading gun, the windage might be much reduced, and in all probability the shot would come out perfectly centred, for whatever advantage is to be gained by the principle of centring is to be found in this gun. And not only so, but the fact that a long gun is the only sure method of obtaining accurate practice could be taken advantage of, for, with a breech-loading gun, there is no limit to the length of the gun which can be made.

I have endeavoured to show, in a lecture recently given here to the Artillery Volunteers, that accuracy of practice at long ranges is what is now most required; and I may now add that, in the gun I have proposed, and in the rifling I have suggested, terrible efficiency at long ranges will secure to England that supremacy in naval warfare which, I thank God, has always been her prerogative.

The CHAIRMAN: Before asking any gentleman to offer any remarks on your paper, allow me to ask you what windage you propose to adopt in your gun as a muzzle-loader?

Captain MORGAN: I should propose the same as in the service gun.

Captain R. SCOTT, R.N.: With reference to what Captain Morgan has said as to the dropping of the shot just on leaving the gun, there can be no doubt but that he gives a perfectly true explanation of its cause. If the studs which are used in the Woolwich system—(to make my meaning clear I must speak of plans which have been tested) —do keep the shot in the centre of the bore so long as they retain their hold on the rifling; then, as these studs leave the support of the rifling before the rear of the shot has left the gun, it is evident from his illustration that the gas must push the shot downwards, and thus cause it to leave the gun unsteadily. The truth of this argument is confirmed by comparing the ranges of the 7-inch gun competition, in which my gun being fired with 20 lbs. of powder, and the French gun, or as it is now called the Woolwich gun, with 25 lbs., both at 2° of elevation, the shot dropped at about the same distance; in fact, my gun had rather a longer range than the Woolwich, although the initial velocity of the latter was, with this much larger charge, greater. Now what had the stud-shot been doing not to have ranged further? They had been gyrating in the air, very much as Captain Morgan has shown in the diagram; in fact the shot, instead of rotating only round their axes, had been also circling round and round like an unsteady peg-top. I do not quite agree with what Major Morgan has said as to the cause of the deviation of projectiles, but I think he has exactly illustrated it with the gyroscope, by hanging a weight on one side. It is the heavier weight in the rear, or, in other words, the centre of gravity being in

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* See *Journal*, vol. xiv, p. 479; and vol. xv, p. 335. A model of this gun may be seen in the Museum of the Institution.

the rear of the transverse axis of the figure that causes the shot to deviate from a straight to a curved path across the vertical plane. To my own mind the reason is plain, and probably it may be made clear to others by this explanation. The larger and heavier circle of the rear of the shot has a greater tendency to maintain rotation than the narrower and lighter circle (section) of its front; and as this front part has also less tendency to maintain its onward momentum, the rear is as it were pushing the front aside in its endeavour to get first. These forces result in the shot's describing a curved path in the direction of its rotation, and the longer the flight, the greater is the shot's deviation. As illustrated by the gyroscope, the shot does not deviate much at first, its rotation being considerable, but it deviates very considerably towards the end of its flight when its rotation is much lessened. Captain Morgan has spoken of the grooving as liable to cause the splitting of the tube into which it is cut, from the unequal stretching of the inner tube by the fired gunpowder gases. I think he has over-estimated this effect, and as my gun has been referred to by him, I can, without entering upon new ground, speak directly to this point. If the grooves of any gun—and, as is the case in the gun proposed by Captain Morgan—be only about ·3 of an inch in depth, the tube of the gun cannot be injuriously cut into. In my 7-inch gun, the depth was ·125 inches, and ·135 of an inch would be quite enough for the heaviest gun rifled on my system; the steel tube, however, instead of being little more than ·125 inches thick, is in reality 3 inches thick, and therefore such rifling would remove but a very small portion of the inner surface of the tube, and would not, in my opinion, materially lessen its strength or interfere with its equable stretching. I do not think that the grooving, *per se*, has ever been found to be one of the causes of the failure of our wrought-iron guns. Experiment has shown that the principal cause of failure is the scoring of the upper surface of the bore from the rush of the gas past the shot; this gradually eats away and weakens the tube, preparing it, as it were, to give way at the places where it is struck by the projectile. This striking action is very intense in the Woolwich gun, for the upper portion of the charge being first ignited, the pressure of the gas falls upon the upper surface of the shot, and the lower studs at once yield to its force; the consequence being that the dropping of the shot to the bottom of the bore allows a great rush of gas over it, and it prevents the rising and centring of the shot. Hence, as the studs interpose but little check to the rush of the gas, and the grooves are large, the wearing effect upon the whole upper surface of the bore of the gun is very great. You come back, then, to these points—you want to stop the injurious rush of gas, and you want to raise up the axis of the shot so as to centre it in the bore of the gun. As regards the centring, I believe it is admitted, as Major Palliser stated in his treatise, that I first pointed out the principle of centring the shot. I think there is no doubt that my plan really does centre it. I beg you to bear in mind that the ribs (bearings) of my shot are continued throughout the cylindrical portion to the end of their base, which is flat, but in the present projectiles the studs are near their centre, and the base is rounded. You could not have a worse form than this, because the gas impinging against the rounded end must have a wedge-like action over the top of the shot which greatly accelerates the cutting or eroding of the bore of the gun. By using studs and the gaining rifle twist, you do away with length of bearing, and hence, before the shot leaves the bore, it is wholly deprived of the guidance of its projecting studs, and necessarily has that great tendency to deviate which Captain Morgan has pointed out. I have no doubt we shall have to come back to the flat base, for the present rounded base of the shot greatly adds to the difficulty of checking the gas, by wads or other means, so as to prevent erosion of the bore. A great many wads have been already tried, but none have been successful, for if the wads be large and tough enough to resist the action of the gas, they would be exceedingly dangerous on board ship, because the wad may fly to the right or left, and do considerable damage to neighbouring ships or boats. Wads, unless they break up close to the ship, are, I think, very objectionable. I am much obliged for the very favourable table which has been brought forward by Captain Morgan. I really had no idea before that the comparisons were so favourable for my system as he has shown them to be; you will see in the second column the relative pressures. With the uniform twist and the Woolwich studs it is given as 18 tons per square inch, and 45 tons per square inch when the pressure has increased to its maximum, but

in my plan the pressure is shown to be 2 tons only, and 5 tons when increased to its maximum; so that, according to this comparison, my system of long bearings has a very great advantage over the service plan of studs. An article on the pressures upon the studs of our service projectiles, from the pen of Captain Noble, is correct in theory but incorrect, I think, in practice. Captain Morgan gave an illustration of this when he pointed out that the studs of the projectiles fired from the 35-ton gun became partially sheared, and that then these studs slipped over the edges of the grooves, tightly jambing the projectile between the lands of the bore of the gun. I think in this explanation we have a solution of the enormous powder-pressures obtained in the first 35-ton gun, for the wedging action must have retarded the shot and tended to increase the powder-pressures. The correctness of this solution is confirmed by what Captain O'Hea recently told us as to the effect of friction in retarding the shot. He stated that by boring out the rifling to within a few inches of the muzzle of a rifle-barrel he got a very much higher velocity than usual, owing to the bullets travelling through a smooth bore until they got close to the muzzle, when there was a little retardation, from the bullets having to cut their way past the rifle grooves. Captain O'Hea's last experiments are still more conclusive as to the retardation caused by friction; these were made with bullets so small as not to touch the rifle grooves, the paper wad alone taking the grooves and giving the necessary spin to the bullets, the result was that he obtained 150 yards more range with the same elevation. May I ask Captain O'Hea how much this is in excess of the service weapon's range with equal elevation.

Captain O'Hea: 225 yards at 700 yards range, that is, I use the elevation for 475 at 700 yards.

Captain Scott: Therefore, this experiment brings out in a very remarkable way what must be the result if the projectile does not easily slip out of the gun. Theory does not teach this remarkable result, but it is found in practice, and I am satisfied from the results that I have seen, and from observing the markings in the bore of the gun, and other indications, that when the first rush of the gas comes upon the stud-shot its rear is pressed violently downwards, and strikes a heavy blow upon the bottom of the bore. The shot then rubs along the bottom, and there is a tremendous amount of friction in pushing its way through the fouling which lies there. This rubbing causes an irregular motion, tending to tilt the shot, thus increasing the retardation, and further adding to the irregularity of the powder pressure throughout the whole distance of the shot's passage through the bore of the gun. The consequent loss of velocity is very considerable, and resulted in that, of all the 7-inch competitive guns—the Woolwich gave by far the lowest initial velocity. I think I have now touched upon the points which concern our present system of rifling in so far as Captain Morgan has gone with his proposals, and, therefore, I will say nothing about weakening the shot, and the consequent danger to the service gun, but only add, that although Captain Morgan has so ably brought before us many new considerations, as to the best mode of dealing with ordnance, and his gun is exceedingly ingenious, I do not think that his rifling would be found upon service to be advantageous. The great number of grooves would always be an objection to it, and I think that the fouling would lie in the small grooves, and that he would find that practically there would be a very great increase in the friction without corresponding advantages. I am satisfied, as I said before, that his proposed wad would be objectionable; and I do not think that he would find that the grooves in the shot would be cut so easily as he supposes. They would have to fit the gun with the greatest nicety, a nicety that I do not think could be ever carried out in practice; and, therefore, although Captain Morgan's is an exceedingly ingenious rifling,—and I quite agree with what he says as to the importance of centring the shot (as I believe all who have studied the question must do), and have learned a great deal from his paper,—still I cannot think he would get those practical results from the use of his rifling which, I for one, should be very happy if he succeeded in obtaining.

Commander W. Dawson, R.N.: This is the first time I have had the honour of meeting Captain Morgan face to face, but it is not the first time I have derived benefit from his valuable instruction. I have to thank him for the profitable reading in some very instructive papers of his, and I thank him very much for the very

intelligent and very scientific explanation he has given us to-night of the rotation of projectiles, and their gyrations in the air. The explanation he has given, based as it is on the gyroscope, appears to me very similar to that we taught fifteen years ago, when I was an instructor in gunnery, as to the cause of the deflection of the Armstrong projectiles. The whole gist of the paper appears to me to resolve itself into the means of obtaining increased accuracy. That is a point which is of far more importance than at first sight, perhaps we naval men are apt to think accuracy has risen very much in importance, in consequence of the unequal distribution of armour in different thicknesses over the ship. When a ship was covered with the same thickness of plating in all parts, she was equally vulnerable or invulnerable, wherever she might be struck, and it did not matter very much what part of the ship was struck; but when there is a patch of 12-inch armour here, and a patch of 10-inch there, and so on, it becomes of the very first importance that you should know what is the particular point that the special gun you happen to be firing can perforate, and what is the part it cannot penetrate. It is even more important to know the spot it will not, than the part it will. You want that information not only for the larger guns, but for every sized gun in the ship. I believe that in the case of one ironclad attacking another, there is no reason why every nature of gun should not be very effectively fought if we had but the requisite skill to plant each shot in the place, the vulnerability of which is adapted to its penetrating power. Therefore, precision of fire appears to have risen very much in necessity since ships have lost their homogeniety of resistance. I point out this the more readily because I think that the principles laid down by you, Mr. Chairman, some five years ago, as to the requirements of good naval guns still hold good, and it is well, I think, to call attention to what those principles are, again, to re-state them in order that we may see how far they are applicable to the various systems and weapons which are brought before us. Admiral Key laid it down that the first and most necessary quality in a naval gun is that, it should have strength and endurance; second in importance, penetrating power up to 1,200 yards; third in value, the use of a powerful shell; fourth in estimation, simplicity as regards non-liability to derangement, and facility of working in the gun, and in the projectile; fifth in essentials, *accuracy with a low trajectory*, especially at ranges under 1,500 yards; sixth, and last, extensive range, which quality, as Admiral Key points out, is not a necessity for naval ordnance. Now, although it is possible that if Admiral Key were writing that minute now, he might alter some portions of it, yet I think the order in which he has placed those qualifications remains still very much as it was in the year 1868. And although accuracy is put down as fifth in importance, you must remember that so far as precision of fire is dependent on the weapon itself, and not upon those who employ it, it is connected with flatness of trajectory, which means high velocity. But high velocity from the same muzzle-loading gun under similar circumstances has a most beneficial effect upon Admiral Key's most important requisite endurance; because the higher velocity under like conditions, evidences that there is less resistance to the escape of the shot, and if there be less resistance, it indicates greater steadiness of flight through the bore, and therefore, fewer dents, abrasions, and enlargements, and consequently better endurance. Further than that, greater steadiness in the bore by giving higher velocity, implies also increased penetrating power which is Admiral Key's second important quality. So that the question of steadiness of flight which has been brought before us so ably by Captain Morgan to-night, whilst it apparently deals only with precision of fire, is dealing with the far more important qualities of endurance, penetration, and shell-power, and opens up a very large question involving many other considerations than those which are specially pointed out. Now, seamen are apt to underrate accuracy because they have certain physical difficulties in practically attaining it, and they do not face those difficulties with a determination to overcome them, as perhaps they ought to do. There are, first, the difficulties connected with our ignorance of the distance, and of the results of our fire. Generally speaking, very little trouble is taken in finding out the distance of the object, and we are commonly ignorant of the results of our shooting. Very little pains is taken to place observers at right angles to the range to watch where the shot falls. The evil influence next in importance is that the front and rear sights are placed too close together, especially in the

rifled guns; and, third in importance is the low velocity, and, therefore, the high trajectory due to our present system of rifling. Captain Morgan has well pointed out that the 40-pounder breech-loading gun was one of the most accurate guns we ever had. But when the 40-pounder was put on the broadside of a rolling ship, and worked alongside the old 68-pounder smooth-bore, "the old 68" beat it hollow. Why? Simply for the reason I have pointed out, that we do not take pains to ascertain the distance; the sights in the 40-pounder are too close together; and, thirdly, lead-coated projectiles have very low velocities, and, therefore, high trajectories as compared with the 68-pounder at fighting ranges. Though precision of fire depends mainly on efficient gunnery training, yet, so far as it is dependent on flatness of trajectory, it depends upon getting the point of the shot to face its work accurately in the air. This really resolves itself very much into what occurs within the gun, in obtaining perfect rotation, and correct centring in the bore. But those two things, rotation and centring in a M.L.R. gun, are also connected again with reduction of resistance, and, therefore, with velocity. Wherever in a windage gun, a proportionately high velocity is not obtained, it is because there is a misapplication of force absorbing the propelling power, some extra resistance resulting either from the lack of coincidence in the axes, from wedging over the lands, or from some mechanical obstruction to exit, acting within the gun. The *Pall Mall Gazette*, which seldom admits anything wrong in our present guns, has pointed out that the French breech-loading rifled field-pieces give about 600 feet more initial velocity than our English field-pieces. The German field-pieces give, it says, 300 feet more than the English field-pieces—the 9-pounders; and we know from some experiments that were made by Mr. Vavasour, at Woolwich Arsenal last November, that he got 1,600 feet of velocity from his breech-loading 10-pounder there as against, I think, it is about 1,300 feet in the service 12-pounder gun. Now, although it is quite true that all this increase of velocity and flatness of trajectory does not take place in consequence of the non-centring of the shot, or the imperfect rotation, yet there is no question that that increased velocity could not be obtained under any circumstances from the Woolwich balanced-system of rifling. From the French competitive trials between a Woolwich M.L.R. 12-pounder gun, and a Vavasour M.L.R. 12-pounder, identical in all respects except the rifling, it appears that 16 feet of initial velocity is the amount absorbed by the short-bearing balanced shot in its efforts to escape from such a Woolwich gun. The want of velocity in our balanced stud system is made still more apparent when we compare the performances of the cast-iron gun of the French of 34-tons as against the beautiful wrought-iron 35-ton gun of Woolwich. The striking force of the cheap French gun is one-fifth greater than that of the costly Woolwich gun. Now, there is one striking fact—take that home! The figures are publicly stated and not contradicted by that generally very well-informed Artillery authority, the *Pall Mall Gazette*, the articles in which are supposed to be written by a well-known Royal Artillery Officer, who is generally very well informed on all these matters. The difference of the striking force amounts to 1,625 foot tons in favour of the French "infant," which is in fact as if they were firing an extra 7-inch $6\frac{1}{2}$-ton gun. This absorption of force affects endurance very much. Wherever there is extra resistance to the shot escaping, there must be extra work done upon the gun that ought to have been employed in driving the shot forward. The reason is very plain. If the shot is not correctly centred, it must, as Captain Morgan very well calls it, "knock" the bore of the gun in its passage out, and the consequence is, that every projectile is so injured in its efforts to escape that, if recovered, it has to be re-cast, whilst the bores are abraded, dented, and enlarged, so as to demand examination after every fifty discharges. Indeed, I find in the recent "Manual of Naval Gunnery," published this year, the following statement with reference to endurance: "The "under-mentioned table, showing the number of rounds which have been fired "from some of our heavy muzzle-loading rifled guns proves that their powers of "endurance are most satisfactory. 12-inch M.L.R. gun (of 25 tons) 359; and, "another, 200 rounds. 10-inch M.L.R. gun, 534 rounds. 8-inch M.L.R. gun, "433 rounds; and, another, 408 rounds." The 35-ton gun is not mentioned, though it fired its last round a year before the publication of the "Manual of Gunnery;" it fired, however, 38 rounds from its 12-inch bore and 35 rounds

from its 11·6-inch bore, before it gave way. The "Manual" does not say what charges of powder were fired, nor with what elevation, nor what interval of time elapsed between the rounds? How many years were occupied in these discharges is also not stated. I think the Navy needs something more than second-hand knowledge of what our military gunmakers have done, and should buy its own experience of its own weapons. The Navy itself has had no practice with these heavier guns, with the 12-inch guns; and whatever we read in the "Manual of Gunnery" for Her Majesty's Fleet, is derived from confidential blue-books, and other publications prepared by our military brethren from time to time at Woolwich Arsenal. Amongst the many verbatim extracts made from Woolwich books and inserted in the "Manual of Gunnery," there is abundant information as to the dents, abrasions, enlargements, and other defects which occur in the guns, and instructions as to the frequent, periodical, and minute examination and registration of injuries, consequent upon what Captain Morgan calls the "knocking" of the shot in the bore, not that the three pages of instructions as to the registration of injuries are wholly taken up with those defects which are necessarily of a very serious character; but most of the injuriesi nflicted by the projectiles bear testimony to the fact of that oscillation of the shot in the gun and non-centring, which accounts for the deficiency of velocity and perforating power. This deficiency of steadiness in the bore influences the accuracy of fire, chiefly by causing a high trajectory instead of a flat one. The deficiency of steadiness, and thus of velocity causes, therefore, a loss of accuracy, of endurance, and of penetrating power, and all the ills to which gunnery flesh is heir. Thus, perfection of rotation with the minimum of resistance, resolves itself into an increase of velocity with a given powder-charge and shot. As to the plan which Captain Morgan proposes for overcoming these difficulties, I quite agree with what was said by Captain Scott, that a multitude of grooves in a muzzle-loading gun which is to be fired with an iron shot, would be open to some practical objections. The fouling might lodge in the small shallow grooves, and cause some difficulty in loading. There must also be a sufficient depth of grooves to allow for necessary windage. Windage is essential in all iron-bearing guns to allow for the expansion of the bore, for difficulties of manufacture, and for the presence of fouling matter, and so on; and where you have a multitude of very shallow grooves, you must have a soft lead-coated, or lead-expanding shot. These are not crucial objections to a scheme which has much to recommend it, in that it gives enormous rifle-bearing surfaces, and that it supports the shot along its whole cylindrical body, diffuses the effort of rotation over a large portion of the bore, and remedies many of the existing defects by steadying the projectile in the bore, and getting rid of that system of balancing the shot in unstable equilibrium upon two studs nearly under its centre of gravity. I should be glad to get further information on this long-bearing system, and especially as to how it is proposed to obtain the centring, for of course, however long and rigid the rifle bearing, correct centring must be an essential part of the system. Captain Morgan has adopted I am happy to see an iron-bearing, and has come to the long-bearing. These are two most important concessions to common sense and experience. But I should like to know how he obtains the centring. These are the great wants of our present guns—long iron rifle-bearings, and correct centring. Adopting those two principles, we shall practically obtain all the advantages that rifling can give to diminish the resistances, and thence to increase the velocities of similar shot, and it is in this direction we must look for that which Captain Morgan seeks, viz., an increase of accuracy in artillery shooting.

Captain Morgan: I must say in reply that I am very glad to find the tolerably favourable reception which has been given to a new view. I came here very dispassionately on this point, and with a view to provoke discussion, and to see what really was the result on the mind of the members of this Institution. I know that very serious objections are taken by some officers in the Navy to the Woolwich rifling; and, however satisfactory it may be so far as it has gone, I think, unless we increase the bearing surface, if we go to heavier guns it will fail, and it is better to consider the subject now, than to consider it after it has failed. In the Royal Laboratory, as Captain Sladen will be able to tell you, they are gradually coming to an increased number of studs, and I am sure he could bear out what Captain Scott

says about the rubbing along the bottom of the bore. I know he has been studying that matter, and perhaps he will be able to give us the results on some future occasion. It is principally to obviate that objection, that I am so decidedly in favour of the wad that Captain Scott takes objection to. If however he will show me any other way of stopping the windage—which windage drives the shot on the bottom of the bore—I shall be very happy to adopt it; but I see no way of doing this, except by stopping the windage over the shot. In the first place, the rush of the gas scores the gun at he has justly observed, and in the second place, it drives the shot on the bottom of the bore, and I would only ask why does Captain Scott object to a wad? I quite agree with him about the flat base, and I have drawn my shot with a flat base, and the only reason why I have put a *big* wad in that sketch is, that you may be able to see it at a distance. It may be any size you like so long as you stop the windage. I must say a word against a misconception about powder pressures in heavy guns. I know something about gunpowder, being Assistant Superintendent in the Royal Gunpowder Factory, and I can see that several officers have been misled, and Commander Dawson is one, as to the causes of these powder-pressures. It seems to have got abroad that the jambing of the shot in the bore is a cause of the intense powder-pressures. I am perfectly sure that the powder itself is sufficient to give the results observed, that is to say, if a powder maker makes one brand of powder and then sets about to make another exactly the same, he may feel perfectly sure he has done so, but he may fire one brand in a 35-ton gun with 25 tons pressure, and the other with 65-tons pressure. Why therefore put down to the studs what is sufficiently accounted for by the powder? We are trying as well as we can to get the powder uniform, and this is one of the most difficult and one of the most important things we have to do. I do not think we have quite solved the whole question yet. I think we must go further into the question of powder for big guns. All pebble powder is proved in the 8-inch gun, but we may have two powders which may give the same pressures in the 8-inch gun, but when fired in the 35-ton gun, one may give double the pressure of the other. I am not particularly bigoted about this system of grooving, but I have had the misfortune to invent a breech-loading gun, and to think that it is the best gun that can be adopted. As was said by the last speaker, the first element in a gun is strength; the first element in this gun, I say, is strength. It is from two to three times as strong as a muzzle-loading gun, because I have taken off the strain which tears the gun longitudinally, and when that is taken off, there is opportunity of applying the metal, so that the gun shall be as strong as possible. To do this, involves that the gun shall be breech-loading, which may be or may not be a misfortune, but strength is the main element. Having got this gun, I had to consider how it should be rifled, and I could not for a long time make up my mind. At first I adhered to the usual system of lead-coating, and here I advocated that system as possibly the best, but Captain Scott completely upset my ideas on that point. Since then I have gradually come round to his views, and have given up the idea of lead-coating. Now I think these ribs are probably the best, and I have gone a little further than Captain Scott, so as to meet all the requirements of the case. With regard to the use of this system with muzzle-loading guns, the objections that hold with regard to muzzle-loading guns of course do not hold with regard to breech-loading guns, that is to say, the fouling of the bore does not take effect at all with the latter. If the gun fouls, the shot will clear it out the next round, but if there is any chance of its not having sufficient play, we have only to make the ribs a little deeper, and to make the grooves a little larger, so that they might even have half an inch play laterally and as much as you choose the other way. Unless you have a breech-loading gun, I do not see how you can have a gun sufficiently strong,—and if you adopt a breech-loading gun, what rifling are you to use? I hope whoever takes up the subject, after he has puzzled as long as I have, will arrive at a satisfactory result. If you have a gun that has windage, as soon as you fire two thousand rounds the bore is worn, and there will be no grooves at all. Stop the windage and you will make the gun everlasting. If our Snider and Martini-Henry rifles can fire 20,000 rounds without the slightest difficulty, why should not our big guns be able to do the same. I go in for strength and endurance. We are very much indebted to the last speaker for what he said about accuracy of firing. I believe it is not properly appreciated. If we have to fight a ship a long way off, the

further off we can sink her, the better. We have our torpedoes now-a-days, and they can be driven under water for half a mile, and perhaps we may get them to drive further. Now it is much better to sink your enemy before he can come near you with his torpedoes. That is my view, but of course I would not venture to speak for the Navy. I do believe that accuracy of fire is what we are coming to, and this will make quite a revolution in artillery. The old style used to be to get as close as you can, to fire off your guns, and the gunners who stuck the longest to their guns, were those that won the day. But now it is science, and long distances and accurate practice that are wanted. I am very much indebted to the last speaker for having pointed this out so well. He also asked me how I expected to get my centring. I only quote Captain Scott on that point: he says "with this system of centring, it (the shot) will centre itself." That can be carried out in this system. It has a bearing surface that will not yield, and therefore the shot will probably centre itself. I provide, however, for more than that. If there is any knocking, it will come on the base, and the base is the last point that leaves the gun. I should therefore put zinc studs in some of the grooves at the base; these will jamb along the top of the rib, and so keep the base perfectly steady the whole way, and insure that the projectile leaves the bore perfectly centred. I am not prepared to go into the statistics mentioned by Captain Dawson about the velocity and endurance of guns. I know we can get sufficient velocity in our guns; we can give a very high velocity. But it is a question of strength combined with velocity. We can make a powder that will give 100 feet more in the heavy guns than is done, but it is very questionable if the guns would stand long at that rate. And I am rather doubtful about the *Pall Mall Gazette;* I am afraid it is rather biassed on the points that have been taken up. I rather think that we have the greatest velocity in our guns, that we have stronger guns than those on the Continent, and that we have greater penetration than any gun in the whole world. But I do not think we have come to the end of the matter yet, for we shall have to go on to bigger guns, and then I believe our present system of rifling will not do. In conclusion, I may say my object was to have a good discussion, so that opinions might be ventilated, and this subject might be approached with all the intelligence and foresight that is possible.

The Chairman: I am sure that all here present will wish me to return our thanks to Captain Morgan for the very interesting paper he has read to us. It is very desirable that the subject of this evening's paper should be thoroughly discussed before we proceed to incur a vast expenditure in building heavier guns than we have at present. Our present system I believe to be the best established in any country, but it is not without its defects. As regards the gun that Captain Morgan has proposed, I cannot help concurring in the opinion expressed by Captain Dawson that these very narrow shallow grooves are liable to foul and to offer serious difficulty in loading, if it is intended to be a muzzle-loader, and the zinc studs at the base of the shot will add to that difficulty. (Captain Morgan: They are applicable solely to the breech-loading gun.) If the system is intended for a breech-loading gun, it seems to me to offer many advantages. It has a long bearing, and the mode of centring the shot appears satisfactory. The windage also in that case can be reduced to a minimum. Captain Morgan said he was "unfortunate" enough to propose a breech-loading gun. I can only say that in my opinion (and I think I express that of the Navy in general), if you will give us a good breech-loading gun, we shall only be too thankful. It is just the thing we wish for, but it must be a good breech-loading gun, free from the defects of all hitherto tried. It is an object much desired by the Navy. One very interesting part of the paper, to my mind, is that table that Captain Morgan has explained to us, showing the different pressures on the bearing surfaces of different descriptions of guns, and the pressures on the studs, especially as bearing on that interesting question of the uniform and increasing twist. But there is one point that I think has not been considered this evening. The principal advantage claimed by the advocates of an increasing twist, is that it adds to the endurance of the gun by equalising the pressure of the gas during the passage of the shot through the bore. I am glad to hear that experiments are going to be carried out to ascertain what the pressures are with the uniform twist and with the increasing twist, and I think that the experiment will be a most important one. If it shows that the pressure with the increasing twist is more uniform during the passage of the shot through the bore, it

will be an important point to the advantage of the increasing twist. Captain Morgan has shown that the pressure on the *studs* is of no great importance; that in the uniform twist, although you have a greater pressure on the stud, yet by increasing your bearings you nullify the disadvantage so far as the studs are concerned. But still, I think, we must wait until we hear the result of the experiments on the pressures on the gun. I beg to offer Captain Morgan the thanks of the meeting for his very interesting paper.

LECTURE.

Friday, June 27th 1873.

General SIR WILLIAM J. CODRINGTON, G.C.B., in the Chair.

ON THE BEST MODE OF DEFENCE OF THE PROTECTED TERRITORIES ON THE GOLD COAST OF AFRICA, AND THE ORGANIZATION OF A FORCE SUFFICIENT FOR THAT PURPOSE.

By Admiral the Earl of Lauderdale, G.C.B.

When I drew up this paper, I was under the impression that all the tribes between Cape Coast and the Ashantee frontier, were under British protection, but there have been laid before Parliament important papers relative to the state of affairs at Cape Coast, which show that, before the Ashantee invasion, matters were in a very unsettled position, and from which it is difficult to make out whether there is really any protectorate at all; but as it is clear that we collect a revenue from the tribes, it appears to me that we are in honour bound to protect and assist them; otherwise I should not trouble you with this paper.

When I read, in one of the evening papers, about three months ago, that the Ashantees had invaded our Protectorate by crossing the Prah river with 12,000 men, I thought it would be a very serious affair, and in my place in the House of Lords, I urged the Government to take immediate steps to prevent supplies of arms and ammunition from getting into the hands of the enemy (the Ashantees), and to collect a sufficient force without delay, as we had, at that time, only one company (2nd West India) and a few Houssa native police to defend the eight or ten forts along the coast under the British flag, and also knowing that the tribes on the coast from the Gambia to Lagos, were in an unsettled state. I believe the great cause of discontent amongst the Fantee tribes was our handing those tribes over to the Dutch by Treaty in March, 1867, against their wish. This caused much bloodshed; but by the last Treaty of February, 1871, they are all again under our so-called protectorate, but it appears they are given to understand that they must fight their own battles and that we will not protect them against the Ashantees: I am not here to discuss the policy of the Government in withdrawing all our troops from the Colonies and protected territories, but I will say this, that the force should not be withdrawn from any colony or protected territory until we are satisfied that they have organised a sufficient force to defend themselves from any impending attack.*

Before entering farther into the subject, I will give an outline

* Two years ago, our colony at Bathurst, River Gambia, was so unprotected that they were obliged to call in the assistance of the French.

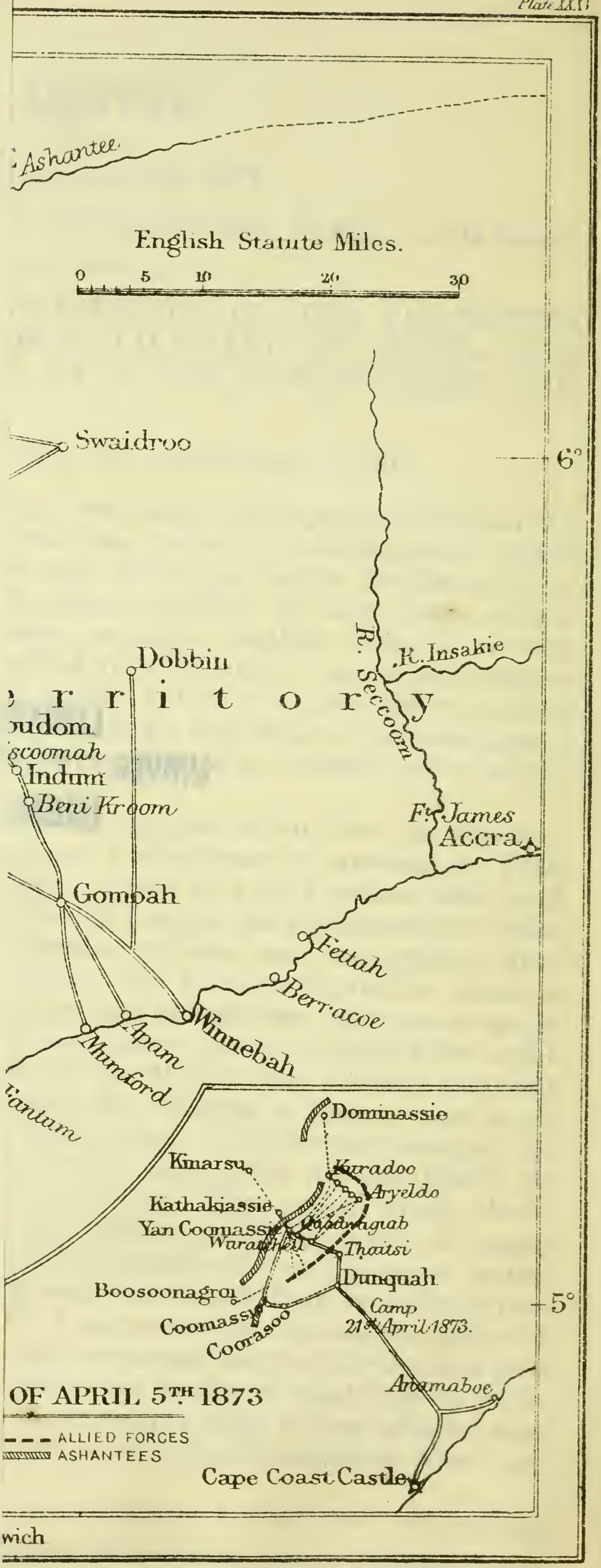
SKETCH-MAP OF PART OF THE GOLD COAST.

Journal R.U.S. Institution, Vol. 17. Plate XXV

Stanford's Geog. Estab^t 6 & 7, Charing Cross.

F THE GOLD COAST.

Plate XXV



Stanford's Geog. Estabt. 6 & 7, Charing Cross.

of the protected territory on the Gold Coast of Africa. It is bounded on the east by the Volta, on the west by the Assinee, on the south by the sea, on the north by the Ashantee territory; the River Prah being the line. Latitude 5° to 6° north, longitude 1° to 3° west. Population about 400,000; area, 14,000 square miles; sea coast about 250 miles, along which there are now ten forts under the British flag. Rivers—Volta navigable, Assinee not known, Prah, Seicoom, and several other small rivers which are fordable in the dry season. Water is scarce, except from the rivers, but can be got by sinking ten feet. Country is level, in general covered with impassable jungle, through which all roads must be cut: there are no wheeled carriages or beasts of burden in the country: products, gold, ivory, and palm oil.

The revenue in 1870 was 36,000*l.*; imports in 1871, 500,000*l.*; exports, 400,000*l.*; but, I believe, it is all much increased since the Dutch Settlements were handed over to us.

The principal towns on the coast are Axim, Dix Cove, Bootry (fort), Secondee, Chama, St. George, or Elmina, Cape Coast Castle, Anamaboo, Accra, and others: the towns in the interior are shown in the map.

The climate is very hot, but considered more healthy than that of Sierra Leone. Winds, generally along the coast, from west to east; rainy season from May to August. There are also occasionally tornados and hermattans.

There is anchorage all along the coast.

The Ashantees are known to be a warlike tribe, and it is said that they are, in a considerable degree, organized into regiments or distinct bodies, under their own Officers, whom they strictly obey; they are well armed. Their mode of warfare is peculiar; they seldom attack our forces when in large numbers, but wait to be attacked, when they do not make a determined stand, but make a sham retreat, and when their enemy is drawn from their position, they turn and attack them on the flank and rear.

The Kingdom of Ashantee, North of the Gold Coast, is thus described by Sandeman in 1837:—

"Its general appearance is beautiful, many parts resembling a "gentleman's park; deer, hares, partridges, wild ducks, pigeons, &c., "are plentiful, but beeves and horses are scarce; it is also very rich in "gold, and populous. The natives are well made, but are a barbarous "and deceitful people, more inclined to be warlike than commercial; "they have no written language, but are famous for making long "speeches in debating on any subject. The King is a very powerful "chief, he has upwards of 200,000 warriors, and has full power over "the lives and liberty of all who offend him, and his authority "extends over several neighbouring states; the capital is Coomassie."

This is the fourth or fifth war we have had with the Ashantees, or rather the fourth time they have invaded the territory under our protection: the first, in 1807; the second, in 1824, when Sir Charles MacCarthy lost his life; the third, in 1853; the fourth, in 1863, serious; and the fifth, in January, 1873, this present invasion, which was not sudden or altogether unexpected; for early in December last year the Kings and Chiefs of the various tribes near the Ashantee frontier (the Prah river)

sent urgent messages to the Administrator for help and protection against an impending attack by the Ashantees, who they declared were preparing against the Assins, Abrahs, and other nations of the protectorate; their sons and relations came saying that the Ashantees were collecting large forces on the other side of the Prah river. No attention however was paid to them until January, when a patrol of police was sent to the frontier, who on the 30th of January returned and confirmed the statement that had been made by all the Kings, and that the country was actually invaded by a large force of Ashantees; that the Kings and Chiefs had no means of defending themselves, having no ammunition or guns. Even then, it was some time before these supplies were given them, and only in very small quantities, although the enemy was burning the villages and murdering the population of a vast tract of country, which they had already seized up to the 30th of January. The King of the Assins sent to the Administrator on this date, saying: "You have sent me word that the King of Ashantee is the very "good friend of your Queen and of yourself and that he cannot mean "war, but I tell you this is war; the Ashantees have crossed the Prah "river and have penetrated 12 miles into my country and have burned "nine of my villages and murdered all the inhabitants, except those "they have sent into slavery in Ashantee. I wait no longer for your "orders, but go to fight my enemy and defend my country." In short, until after the battle on the 10th March, no assistance and certainly not a sufficient supply of ammunition was given to the native tribes. This, I believe, to have been the chief, if not the sole cause of their defeat, and in this I am supported by the following:—

Circular to the Foreign Ladies residing at Cape Coast Castle, March 13th 1873.—"Dear Friends, news having been received from the camp "of the rapid advance of the Ashantee forces invading the Protectorate "States, and it being imperatively necessary that speedy and immediate "measures be adopted for repelling the invasion, the native ladies of "Cape Coast have resolved on levying amongst themselves contributions "for the purchase of munitions of war and arms, in order to aid the "fighting men in re-taking the field against the enemy, and therefore call "upon the foreign ladies residing here to lend their pecuniary assistance "according to their ability."

"£150 has been collected. The Ashantees, 30,000 strong, are within six hours' march of Cape Coast."

Up to the time of the second battle, 150 barrels of gunpowder had been given them, being only about twelve charges for each man, the force being forty thousand.

The first battle was fought on the 10th March, 1873; the Ashantee forces are supposed to have amounted to 30,000 men, armed with muskets, but no artillery; the forces of the various Chiefs and Kings under our protectorate were calculated at about the same number, viz., on the right of the line, first, the Buaffoos, under King Edoo; Inkooskooms, King Essandoh; the Assins, under their King; to the left were the Abrahs, Anamaboos, Dankara, and part of the Assins, under King Chibbo, and Inki, one of the Kings of the Assins; the Gomoahs—a large tribe.

The first shot fired by the enemy was against the Abrahs, who returned the fire, and continued to fight most gallantly under their king. After the first volley into the Abrahs, the enemy commenced an attack on the whole line, where they met with a stubborn resistance, and the battle raged furiously for several hours from right to left, the Ashantees being well led by their chiefs, and our forces being no less so by their Kings; all of a sudden, the firing on our right flank began to slacken, whilst that of the enemy had in no way abated; this was caused by a panic, which had seized the Cape Coast men, who believed the enemy had outflanked them, and King Edoo, having been unable to maintain his position, had withdrawn his forces from the field. Nothing could induce the Cape Coast men to remain at their post, and they rushed back to Cape Coast, bringing the news of the defeat of our forces, but such was not the case; at that time, the Abrahs and Anamaboes and others were still fighting bravely against terrible odds, their kings and leading men each vying with each other who should outdo the other in bravery, but, by the withdrawal of the Cape Coast men, and the retreat of King Edoo with the people of Buaffoo, our line was open to attack from rear and right, the Ashantees having taken Yancoomasie, which was the key of our position; the Houssa force, which was in the rear, did not assist. It was now getting late, the Abrahs and Anamaboes still holding out, although nearly enveloped by the enemy, but it was all to no purpose, their *ammunition failed* them, and they were obliged to retreat, and the Ashantees pressed on and got possession of our camp; meanwhile, as the battle was raging, part of the Assins under Inkí on our right, and the remainder of the Assins and Buaffoos on our left, who had taken but a slight share in the action, had stolen into the rear of the Ashantees, and plundered their camp and carried off a number of prisoners; this prevented the Ashantees from following up our retreating forces; thus ended the first battle. The second battle was fought on Easter Sunday; our forces were posted (as shown in the sketch) occupying a half circle of about ten miles, and advanced along their war paths; they fought well for six or seven hours, and at first drove back the Ashantees, but their ammunition again failed them, and they were obliged to retreat, and eventually to disperse. The Houssa force of about 200 men rendered good service. On the 21st of April, the Ashantees were within a few miles of Cape Coast Castle. I believe a confederation of the tribes, under the direction and sanction of the British Government, would be the most beneficial on the whole. The late confederation was arranged without the knowledge of the protecting powers at Wankassin, Kings Edoo and Anfoo Oloo being joint King-Presidents.

Cause of the War.—The King of Ashantee states, that being the grandson of "Ossaia Tutu," he owns Elminas to be his relatives, and consequently the Fort of Elmina with its dependencies are his. He could not understand Mr. Hennessy's message, the Administrator-in-Chief sending Mr. Plange a Dutchman, to tell him that he had taken possession of them for Quakee Fram, king of Denkera, and giving him notice that in four months' time he would come and take power from him.

The King says he has been made angry by this, and it was this which led to his sending his great captains and forces to bring the King of Denkera to Coomassie, who dares to take his Elmina Fort.

The King also claims the Assins and Akims who he says are his slaves, and who have united with Denkera to take power from him, and that nothing will appease his anger, unless they and Elmina are given up to him.

Having given a short outline of the country and of the several invasions of the Ashantees, I come to the object for which I have brought this subject before the Institution, namely, how such invasions are to be prevented and resisted in future. It appears to me that, by proper organization and combination of the tribes under our protection, there would be no real difficulty in the matter; but, before I go further I will venture to state that, if in the beginning of last December, when it was first known that the Ashantees were collecting a large force on the frontier, a similar movement on our side had been made, with proper arrangements for a good supply of ammunition and a force of Houssas collected and raised ready to advance if required, the invasion would probably have been checked at once. Now to be prepared to resist invasion, it appears to me the following measures should be adopted:—1st. Get a good military map of the country, or at any rate of that part of the frontier where invasion is likely to take place, and near the great roads from Coomassie to the coast. Have a strong earthwork, or stockade, or entrenched camp in proper position near the frontier and commanding the roads. Let a regular plan of resistance be laid down and explained to all the tribes, particularly on the frontier, such as this:—When they first hear that the Ashantees are mustering in force on the border, the tribe nearest the point should prepare and send immediate notice to Cape Coast (possibly a line of telegraph might be laid; it is only 80 miles), and nearest tribes on each side should join them. A second stronghold should be made, say about half way in front of Yancomassie or Mansue, whichever would be the best position, where a good reserve should be stationed with plenty of spare ammunition (I am supposing hostilities had commenced). The number of fighting men in each tribe should be ascertained from time to time; the position of each tribe in the line should be clearly laid down, and in case of a retreat, where they have to fall back to, which would be an earthwork or stockade, which would give them shelter and enable them to rally. A few native and one or two European instructors should be attached to each tribe, all having the same instructions from Cape Coast. The women would probably carry all stores and provisions; they can carry great weights on their heads (see account of war in 1824, by Major Ricketts). There are no beasts of burden in the country, nor any wheeled carriages. The tribes should be instructed that, when in position or otherwise, they should always have proper outposts and patrols to the front, so as to prevent surprise; they should also organize spies or scouts. The want of this has been the cause of serious disasters.

It has been suggested that we ought to have a diplomatic agent at the Ashantee capital, Coomasie, but this I believe the (our) Govern-

ment object to (see Parliamentary papers); perhaps they are right, but at any rate we ought to have a trustworthy agent as near the frontier as possible, so as to insure the earliest information. Proper arrangements should be made for a supply of water; tube-pumps would be useful, as they can be taken to pieces and easily carried; the force should have mitrailleuses or Gatlings (I believe this is by far the best description of weapon for the country, and I am supported in this opinion by all Officers to whom I have spoken on the subject), small field guns, and rockets, a good supply of trenching tools, such as the natives can use, should always be kept in store at the Cape Castle. I think it an important point that, when we are in sufficient force to check the Ashantees in front, the spare tribes should always attack them on the flank and rear. This appears to me to be a question of considerable importance, for the enemy can only advance along the roads in single file, so that 40,000 men would form a line 20 miles long, which would be open to attack, the whole of that distance, by small bodies of men. It is only when they are taking a position, that they clear the jungle so as to enable them to present a large front.

The next point is, what forces should we have always ready on the spot? I believe the Houssa force is the best; they are a Mahometan race, from the up country near Lagos, and are known to fight well under British Officers, and can be had in any number, at least, for our wants; they are powerful men, not affected by the climate, and cost about one-half of what any other troops would cost.* Sending European troops to operate in that country appears to me out of the question, and even the West India troops require to be acclimatized; all this is well known from our experience in former wars. There would be no difficulty in getting European Officers to volunteer for the service by giving them adequate pay and promotion. The objections to British troops are, first, that they cannot stand the climate; second, the length of time before they can be brought from England; and thirdly, the great expense incurred.

The various castles could be held by a few regular troops, and in an emergency, by men landed from the ships. In most cases the forts can in some measure be protected by the long range guns from the ships. Military Officers who have been in the New Zealand or Cape wars, would be most valuable. There should be a large number of militia and volunteers. We are accustomed to organize or fight with savages in all parts of the world, and there can be no reason why we cannot manage and get the better of tribes on the Gold Coast. It is clear that some decided plan of defence must now be adopted; of course it will cost money, but nothing can be done without that, and I believe the protectorate would easily pay the interest on the necessary outlay; and when peace and security were established, they would have no difficulty in paying the capital.

This subject would have been more properly and efficiently brought before you by a military officer. I do not put this forward in any way as a matured plan, but only to hear the opinion of competent military

* Their pay is thirty shillings a month inclusive, but when in the field they have a ration free, or threepence a day in lieu of it.

and naval men, many of whom have served against savages both ashore and afloat in various parts of the world. These little coast wars are generally carried on by both forces combined; I myself have been employed co-operating with the Army on the north coast of Spain, in India, and in China.

I believe there should be about a thousand Houssas, and a similar number of Militia and Volunteers, along the coast, between Sierra Leone and Lagos, ready to be collected on any one point when required, and I am under the impression that if such a force were collected, and the Cape Coast men properly organised at the present moment (the rainy season), that they would be able easily to drive back the Ashantees when the season for operations commenced.

Latest accounts :—

Important Message from the Camp Cape Coast, 16th May, 1873.

Chibboo, King of Assin, Quabinah Effah, King of Akim, and Aquasi Kaye, King of Denkera, send Prince Coffee Masu to His Excellency Colonel Harley with the following message :—

" They acknowledge with gratitude that your Excellency has done a " great deal for them in this Ashantee invasion, but they would further " implore your Excellency to compel the Cape Coast people and other " Fantees to go to the camp to assist them in driving their common " enemy out of the protectorate.

" If any of the tribes have offended your Excellency they humbly " beg that you will not, on that account, allow them to be taken by the " Ashantees.

" They beg that your Excellency will divide the *Ahbrim* people into " two divisions, and send one to the camp.

" They beg your Excellency to do all in your power to force an " engagement with the Ashantees *at once*, or they will take possession " of Afootoo, which is close to Denkera.

" At present the great bulk of the Ashantee Army have moved on " to two places called *Secebu* and *Assantee*, near to Denkera, on Mon- " day last the 12th instant. They beg that your Excellency will write " to the Accras to come and assist them.

" They beg for more ammunition, and at least 70 muskets.

" The Kings would especially beg your Excellency to compel the " Cape Coast people to go to the camp at once, as they feel sure they " won't move unless they are forced to do so.

" The Denkera people by their King beg your Excellency to let them " have a loan of fifty Benders of gold to assist them in this war, and as soon as it is over, the King will return it.

" His
" Coffee × Masu
" mark.
" Special messenger, from the
" Kings of Assin, Akim,
" and Denkera."

Dunquah, the Capital of Denkera, Besieged by the whole Ashantee Army.

From accounts received late on Sunday night, it appears that the Ashantees have almost removed from Dunquah, their old camp, and concentrated their forces in the bush about five miles to the south of Dunquah.

The greatest fears are entertained that King Aquasie Kaye with his troops will be compelled to retreat, and leave his beautiful fertile country in the hands of the enemy.

Not a single Cape Coast man or Fantee has made the least attempt to go and assist this unfortunate Prince, although for the last two months he and his brave people have been assisting the Fantees, when Yancoomassie, Dunquah, and other villages were attacked by the Ashantees.

The King of Dunquah has sent to inform His Excellency that he cannot hold out much longer against the whole Ashantee Army, and must of necessity retire with the whole population of Dunquah to Cape Coast for protection, unless he can obtain similar aid to that he and his people rendered to the other Fantee tribes for the last two months or more.

Captain E. ROGERS, Staff Officer of Pensioners, Longford: I was present when Captain Brackenbury delivered here a very effective lecture " On the Tactics of the Three Arms, &c.," and I was surprised that neither he, nor any of the speakers, referred to the part that mitrailleuses are destined to play in future actions, as most countries in Europe have adopted some modification of that weapon. Russia, in particular, has organised fifty batteries, or 400 Gatling guns, and I believe they have been used in the Khivan expedition. America, too, has brought into use fifty small camel-guns for service against the Indians in the Western States. Surely, then, no scheme of tactics can possibly ignore their existence. But Captain Brackenbury confined himself to civilized contests, so to speak, and therefore the exceptional circumstances referred to in Lord Lauderdale's exhaustive paper were not contemplated by him. After very considerable study of this subject, I venture to assert that there is no gun so admirably and essentially adapted for the purposes of either attack or defence in savage warfare, as the Gatling. It is handy, light, and effective; it does the work of many men, without being subject to the endemics of pestilential Africa, and it possesses an inestimable quality in the fact that it produces an unquestionable moral effect on the strongest nerves. The Prussians who, on all other occasions never failed, did not like to face the Gatling gun, or man-mower as they called it. In fact, so thoroughly convinced am I of the effectiveness of this gun that, when the first news of any serious danger to our settlement at Cape Coast arrived, I volunteered to go there in charge of a battery of Gatlings. The Government did not accede to my proposition. Since then I have had a letter from my friend the Administrator-in-Chief, in which he says, " How I wish you were here with me in command of a battery of Gatlings." With regard to the defence of the Protectorate, I would humbly suggest, as the most feasible means of protecting our settlements in the future, to re-embody the 3rd West India Regiment; the present two West India regiments being insufficient to carry out the duties in places so far apart as the stations on the West Coast of Africa, and in the West Indies. The Houssas are very well in themselves, and Colonel Harley speaks of them in the highest terms as dashing fellows and good soldiers, armed as they are with the Snider ; but I venture

Note.—The paragraphs headed " Cause of the War," and " Latest Accounts," are taken from the *West African Herald*, Cape Coast, 17th May, 1873.

to question the expediency of entrusting our interests to any one tribe, for they will inevitably become arrogant and self-sufficient, and will probably end in a mutiny, as befell a similar policy in the case of the Gold Coast Artillery—a local corps. Of course, the Houssa element is very desirable, but I would not employ it exclusively. It may be said that there will be some difficulty in keeping up a staff of eligible officers to properly organise the force on the spot, for it is a very delicate and difficult duty to organise these tribes, and the Officers so employed must be Europeans. That some of us are able to go through service on the coast, I may mention that I have had 14 years in the West Indies, and that I served a year and a half as Garrison Adjutant at Gambia, and my friend beside me, Colonel Ireland, has 33 years' service, of which 5 were passed on the coast of Africa; we are no bad specimens of the effect of climate! It is owing to Colonel Harley's judicious employment of Lieutenant Hopkins in command of the Houssas that the successes hitherto gained may be chiefly ascribed, for this is the first occasion on which the Fantees met and successfully withstood their inveterate foes, the Ashantees. The only reliable system of continued resistance, is to bring the Chiefs to an united and resolute line of policy, and so far Colonel Harley has certainly managed to do so, as was borne testimony to by Mr. Knatchbull-Hugessen in the House; but you must, in addition, have a nucleus, a reserve of regulars, to fall back upon. The tribes should be merely regarded as outlying pickets to the main body on the coast, which, though inferior in numerical strength, should be excellent in kind, and should be supplemented by Gatling guns to make up for disparity of numbers, a few—say four—large calibre* guns should be supplied for fort-defence, and a mixed battery of ordinary ·45 Gatling and camel-guns (which latter only weigh 125 pounds) for other purposes. Small guns would be invaluable in a country which you have heard described as destitute of means of locomotion, and with no beasts of burden of any kind. It is an error to suppose that Gatlings are so delicate and complicated. The locks certainly are marvels of ingenuity, but so is the lock of any ordinary rifle. Naturally our taxpayers are anxious to see the cost of Imperial assistance lessened instead of increased; but if we retain these Protectorates we must abide by the consequence, and be prepared to sacrifice our prejudices to the necessity of the case. And when all is done that can be, what remains? Our dealings with the West Coast of Africa have more or less partaken of a sentimental character, while the few that profit by our possessions there, stimulate and foster this tendency. It seems as if England's policy were at the whim and pleasure of an interested minority. Speakers both in and out of Parliament should take up this question and deal with on its merits. Let the press open its mouth and discuss the bearings of our relations on the coast, and I cannot doubt the conclusions that will be arrived at. I conclude my remarks with this sentiment: "Ireland may not be for the "Irish; but for mercy's sake let Africa be for the Africans!"

Mr. Swanzy: I think I can show you that our influence in Africa is not altogether that of money, but in fact that we, on the contrary, are striving to do some good. I appear here as the representative of the Fantee tribes, because I have been for many years connected with that part of the world; my brother fought and died against the Ashantees, my uncle defended the fort of Cinnamaboe, with 32 men, against the whole Ashantee army, and therefore I have a right to speak. I have been resident there six years, and I have, in fact, by far the largest trade in that part of the world. Let me first account to you for the disorganised state of the Fantee tribes. At the termination of the Macarthy war, and of the battles that followed, Mr. Maclean was sent out as President, under the direction of a committee of merchants, who managed the affairs of the West Coast of Africa in London. He went out, and by his personal influence and tact, with the assistance of £4,000 a year, he managed to extend British influence in every direction. He completely put a stop to the slave trade in that part of the world, and he extended British commerce and civilisation in every direction. That was done without any definite law at all, without any definite granted power; he simply used the tact which God had given

* The gun referred to is the 1-inch ten-barrel Gatling, from which 3,000 missiles can be discharged per minute when using canister cartridge.

him, and nothing more. I myself commanded two little forts on the Coast under him, and the only means I used at that time was to send my cap or my stick to any man guilty of any crime, and he came down and I punished him, or did what was proper in the case. Therefore much was left to ourselves, and in that way I put a stop to accusations of witchcraft and many other evils which had been prevalent on the Coast, and which were a great bar to anything like commerce and civilisation. In 1830 Mr. Maclean formed a treaty with the native tribes and the King of Ashantee, under which the whole of the tribes as far as the Prah were, so to speak, under the protectorate of the British flag; but they then understood, as they do now, that they were to protect themselves. They were ready to protect themselves, and Governors were sent out, military men. I do not wish to depreciate military men as Governors; in many instances they make the most able men. Unfortunately the climate is not healthy, and therefore Governors have not been able to remain long, and, so to speak, to associate themselves with the interests of the natives at all. They absorbed all the power: they took away from the native Chiefs the jurisdiction which they possessed under Maclean; because, in my time, all the Kings of the different tribes had judicial power, levied fines, and had other means of raising a revenue: but when the Governors of the Gold Coast thought proper to absorb all that power, the native Chiefs no longer had the means of raising revenue, and became like so many private individuals, without a sixpence in their pockets. That was the position in which they were when the King of Ashantee, in January 1873, crossed the Prah and came down upon them. They literally have not means enough to buy a keg of powder to defend themselves. The only great victory we have obtained over the King of Ashantee was principally fought by merchants at the head of their people, and of the different tribes, men whose names would not be known in this room; they fought their own battles, and so they would now if they were allowed, but no, it is not allowed. I went out in 1853 myself, sent out by Sir Stephen Hill, and took charge of a force. We had no fighting, fortunately, for I am not a fighting man. But what must be the position of men in this state? They have no means of fighting, no organisation whatever; the power of the Chiefs is no longer acknowledged by the people, and the Government would not allow them to take any part. The moment war breaks out, the Governor sits down in the Castle and says—"Gentlemen, I am ordered by Her Majesty's "Government not to assist you in the slightest way." After a great deal of intercession on the part of the natives and merchants, he serves them out not 150 barrels of powder at one time, but, by dribblets, 10, 15, 20 barrels of powder at a time. Why, I have nearly given out as much myself on my own private account. It is a miserable thing, a case of £450 at the very outside. Her Majesty's Government say it was necessary that Colonel Harley should retain sufficient ammunition in the forts to defend them. Why, 32 men defended a fort, in 1807, against the whole Ashantee body. They cannot take an English fort there under any circumstances. Moreover, there are vessels of the Fleet lying stationed all along the coast who would blow them to atoms in no time. As far as ammunition is concerned and the necessity of saving it, there were plenty of ships full of gunpowder there, had His Excellency chosen to buy it. That has been the great mistake. Colonel Harley has not backed up the men sufficiently. Lieutenant Hopkins and three or four Englishmen only, did everything; it is to them that is owing at the present moment the safety of Cape Coast Castle,—to Dr. Rowe and Dr. McKellah, and two Officers of the Houssa police. Now, they have plenty of force; but what has happened in the mean time? The whole country is devastated in all directions, and thousands of poor creatures have been dragged away to slavery or to butchery in the interior. A friend of mine at Bristol, Mr. King, a well known merchant said to me, "I hate to see Her Majesty's flag flying on the coast. Give "me a native chief and I can trade, I know what I am doing; but give me Her "Majesty's flag and I do not know what I am doing." The revenue of that part of the world is not less than £40,000 to £50,000, and that might be raised to £100,000 which would be ample not only to maintain the safety of the settlements, but to spread their influence into the interior. I do feel deeply on this point, and I am much obliged to your Lordship for speaking on this matter. Your Lordship made use of the word "defection" on the part of the natives. Your Lordship is quite

right, there are three great tribes who themselves are able to cope with Ashantee, if they are united, the Dunkras, the Akims, and the Assins, who were formerly under the Ashantee dominion; any one of these three great tribes could cope with the King of Ashantee. It is not easy to fight a large body of men in a country like that; a small body of men is amply sufficient. The fact is, it was the total want of organization on the part of the natives that led to this disaster. It is the taking away the power they formerly possessed, and then, when the crisis comes, doing nothing to assist them, that has been the cause of it all. I took the liberty of speaking to the gentlemen at the Colonial Office, and suggested the necessity of sending out provisions; because, it is very clear, that famine will ensue. April is the month for planting, and, owing to the disturbances this year, a large portion of the country will not be cultivated. The Government have since done very well; in fact, ever since you Lordship's observations in the House of Lords, and since they have ascertained what has taken place and the reality of this invasion, they have done all they possibly could, to mend matters. In the meantime they were deceived. Colonel Harley estimated the number of the Ashantees at something like 4,000. Mr. Pope Hennessey did the same. He thought it was a mere raid, and he told me also it is customary for the King of Ashantee to break his staff as a declaration of war; and then the Ambassador is sent back and war commences. In this case he had the advantage of surprise; and our own people are not allowed the advantage of surprise. I must thank your Lordship before I sit down for the interest you take in this matter. I have myself contributed something towards scientific discovery in Africa. I take more interest in Africa than that of the mere question of trading. Every proper-minded merchant does so; he does not think only of pounds, shillings, and pence. You, gentlemen, do not, I know, in your profession; and why should you accuse us of anything like that? It is perfectly true that, in old times, when the Slave Trade was prevalent there, we had the strongest sympathies of the British public. That time has passed away, and we are now left to ourselves and are told we must provide for ourselves. We are thankful to be allowed to do so. The cause of the last Ashantee War has been mentioned. In addition to Elmina, among other things the King of Ashantee wishes to get back these tribes, the Dunkras, Akims, and the Assins to his power, for they formed part of the Ashantee tribes. I think the estimate of your Lordship is right—that they number something like 40,000.

Major Knollys, Garrison Instructor, Home District: Before commencing, I must apologise for presuming to take up your time. I have never been on the coast myself, and have no personal experience; but ever since this Ashantee war has begun, I have followed its course with the greatest interest, and have had further the advantage of reading a vast number of letters from the coast, and of personal interviews with a great many people of considerable experience. It has always struck me as a very singular circumstance that we take so little notice in England, of the Coast of Africa. The aggregate of imports and exports, according to the last returns, being about two and-a-half millions, or equal to that of Jamaica. I have every reason to think, from the different returns I have seen, and the opinions I have read, that that is capable of being enormously extended. My own opinion is, that we have only just tapped the surface of the outside of Africa, and that it is capable of a development which will surprise even those who are best acquainted with the subject. As to the cause of the war, I understood in addition to the money paid by the Dutch to the Ashantees for Elmina, under whatever form it was—whether a complimentary payment, or whether they chose to interpret it as a tribute—that there was another reason, which was, that the Dutch used to pay the King of Ashantee so much per head for slaves, whom they employed as troops in their other colonies; and by that being put an end to, the King of Ashantee lost a very considerable amount of revenue. With reference to the Protectorate, I must say I think we have behaved in a most cruel way to the Fantees. We have treated them just as if we had tied their hands, put them in front of a powerful foe, and then said, "You must defend yourselves." There had been, originally, a confederation; and, two years ago, the Fantees endeavoured to revive it. They went rather far before applying to the Administrator, for they had actually appointed an Officer, and drawn up a Constitution. The authorities were indignant that matters had gone so far, without their leave being

asked; and they did not encourage the movement. The recommendation of the Committee was that they should be encouraged to defend themselves as far as possible. In spite of that, as soon as ever they took their first step towards it, merely on account of a breach of etiquette, they were immediately sat upon by the Administrator, and five of them committed to prison on a charge of high treason. His acts were said to be repudiated by the Colonial Office and by the Governor-in-Chief afterwards; but they were repudiated in a very mild way. The tribes were put off from time to time. The last scheme they submitted was six months without receiving any attention; and then came the Ashantee War. It seems to me that our prestige and honour has been very seriously compromised. One of the great complaints of the merchants—native and European—on the coast in the different stations in the protected territory is, that they are not given to understand how far the ægis of the British protection extends. One Governor interprets it within shot of the guns of the different ports, and that is all that he will undertake to defend. Another extends it for two or three miles. But while there is this inconsistency with regard to protection, there is none whatever with regard to taxation. I understand that while they are not at all ready to defend the commercial interests of merchants at a distance, they take uncommonly good care to collect their revenue. There was one case that I read in the *Manchester Courier* the other day. A gentleman said there was a settlement on the Volta where a tax-collector came round to collect revenue duties on the imports; and there was a tribe on the other side of the river whom we had, in vain, endeavoured to bring under our rule, and who refused to be taxed. They stopped all commerce in the river, and attacked and burned the station, destroying a large amount of property belonging to native and European merchants. Application was made to the Administrator for redress; but he refused to give it. The merchants said, "we pay taxes and are entitled to protection." "No," he said, "Her Majesty's Government will not undertake to defend those people who are trading at a great distance, and if they continue to trade at that distance, they must do so at their own risk." Upon which, they put the question to the Administrator as to what was considered an out-of-the-way place, and how far the protection of the British Government would extend. The answer he gave was, that was a question to be asked him by superiors, and not by individuals. That caused a great deal of indignation on the part of everybody on the Coast—both Fantees and Europeans, and it was said that it was ridiculous to talk about it being a protected State, because it was not we who protected the Fantees, but the Fantees who protected us. And if it had not been for the Fantees the other day, the Administrator would have been shut up in Cape Coast Castle. With reference to the method of defending this district, I have understood from reports of different Officers on the Coast, that neither British nor West India regiments can be employed with advantage in the interior—that their health will not stand it; and I am told that the only force to rely upon are the Houssas, which already exist. They were started by Captain Glover, the late Governor of Lagos, and numbered 350 men, 300 being armed with Sniders, and the remainder trained to work artillery. They are excessively well disciplined and well-trained men, and have already done good service in these countries. In the first action there was a body of 120, some few miles in rear of the Fantee forces. They were restrained by the instructions of the Administrator from giving any but moral support; but that moral support was not of much use, and the Fantees had to run away. On the second occasion they did uncommonly good service, and lost about 16 men out of the 120, killed and wounded. The danger alluded to of risking all our strength and putting all out trust in one tribe is, I think, a little overrated. The circumstances are not quite the same as in India, nor with regard to the Gold Coast Artillery Corps alluded to, for the Houssas would be serving out of their own district, and therefore you might rely upon them. They have never given any sign of insubordination; in fact, ever since their formation they have given their superiors the very greatest satisfaction. Captain Glover was very anxious to increase this force, and, had he been allowed to do so, there would have been a very powerful body of men under their commandant, who was an officer in the British Army, and served with distinction in the Siege of Lucknow, Mr. Goldsworthy. If he had been able to bring some 500 of these men to meet the Ashantees on their first invasion, I have no doubt the issue of the first

battle would have been very different. With regard to the estimate of numbers; the numbers have been estimated very largely indeed; and I believe that is explained by the fact that for every fighting man in the Ashantee force, there is a camp follower; therefore you may take half the number of men given as about the fighting force. The total number being given at 80,000, the fighting force would be 40,000. With reference to the future defence of the country, there is this objection to stockades, that if the tribes had to retire and to take refuge in them, they would be obliged to bring their women and children with them; therefore, I should imagine, instead of erecting these stockades outside villages, it would be the best thing to fortify the villages themselves. This, however, is only a matter of detail; the principle is exactly the same. The main point seems to me to be that we should assume the offensive; the Ashantees have never yet been thoroughly threshed; indeed they have always had sufficient reason to think it was quite doubtful whether they licked us, or we them. I cannot help thinking if we were to make up our minds to finish the business and go into the Ashantee country, it would save us a very large amount of money in the long run, and no doubt would largely increase our prestige on the Coast, and render the danger of future wars very trifling.

Commander Verney, R.N.: Just three years ago I was about to embark for the West Coast of Africa, and on landing in England this morning, after an absence of three years, I saw at the Admiralty a notice of Lord Lauderdale's lecture. The enjoyment of two years in the Mediterranean has not effaced from my mind the miseries of the months on the West Coast of Africa; and since I have been there, a thought has often arisen in my mind as to what extent it is the duty of Englishmen to be employed on that coast at all? If there is any question of duty, English Officers are ready to go at any expenditure of life and any amount of suffering. But I have failed to see where there is any call of duty to Englishmen from the West Coast of Africa. It seems to me, before we consider the subject of how one is to protect such a great extent of country, the question should first arise whether it is our duty to do so at all. Lord Lauderdale drew an analogy between our reducing our forces in a colony and reducing our forces in a Protectorate; it seems to me there is no analogy at all there. We have a duty to our Colonies, but what duty have we on the West Coast of Africa? What duty have we to protect that large extent of country? Who wants us to protect it? The natives do not want us to protect it. The merchants do not want us to protect them. The gentleman who spoke just now (Mr. Swanzy) told us he does not want our protection, and that they can get on better without it. What is the nature of the protection we have afforded? We have afforded no protection whatever to these people. This very war goes to prove the case that we are quite unable to protect them. Then, what have those who have served on that coast suffered? How have people returned from the coast? Utterly broken in health, utterly useless for their profession hereafter, merely through service on that desolate and abominable coast. In some of our colonies, for instance in British Columbia, there are parts of the country where the merchants are told that, if they chose to go and trade, they shall receive British protection, but if they chose to go to other places they must protect themselves. There you have either the one thing or the other. Either the British flag is there and is able to defend itself, or else you are told you must defend yourselves if you want to go and trade in the wilder parts. Why cannot the same thing be done on the West Coast of Africa? It seems to me it would be perfectly feasible that there should be certain parts of the Coast, such as Cape Coast Castle, where British law and justice should reign, and that if the merchants choose to go and trade in other parts, they must do so at their own risk. How is it possible for us to protect the whole of that great tract of country because, practically, our protectorate goes up beyond Fernando Po. (Lord Lauderdale: Our protectorate merely extends between the two rivers Volta and Assinee.) But the red line on the map extends into the Bight of Benin; it extends up to Lagos, and there is a large extent of country which I venture to say it is quite impossible for us to protect. No gentleman has yet suggested that view of the case, and I shall be glad to hear, if anyone will condescend to do so, how it strikes any gentleman present that it is our duty to extend the light and help that we at present afford on that coast. The very day that we left the coast in the "Growler" there came off a poisonous wind from the shore, the worst that I have

ever experienced, and two days afterwards quite a third of the ship's company were laid up with fever. By the mails that we received shortly afterwards, we heard of several deaths that had occurred from this poisonous wind that came off on the very day we left that pestilential coast. I should be very sorry to think that any Officer was sent out to organize troops there, or to carry on operations in the interior, unless it was first made perfectly clear that it was our duty to maintain our protectorate over so large a portion of the coast.

Captain BEAMISH, R.N.: I came here quite unprepared with any observations on the subject. We cannot but thank Lord Lauderdale for bringing this subject—so very much connected with British prestige—not only before Parliament, but also before those who are able to speak upon it. I do not agree with the gallant Officer behind me (Captain Verney) as to our protectorate, particularly from the point of view in which he regards it. I think, however, that what is called our protectorate there might better be called a confederation. I think we have taken the heart out of these fine tribes in that part of the world. We have not allowed them to have very much to say for themselves, and then, when they are in the lurch, we are not able to help them. I do not think we can defend that part of the world by any means, and in that way I agree with Captain Verney, and I think it preposterous that we should attempt to do so with Europeans. A gentleman on my left, who spoke about the Houssas, spoke extremely to the point. Captain Glover, who has lately returned from that part of the world,—one of the most valuable men who has worked out there for a large number of years, certainly one of the most energetic and far-seeing,—I won't say the inventor of Lagos, and certainly the inventor of the Houssas, got rather snubbed for a good many things connected with these Houssas, but he has carried out his views, and the Houssas have been found to be invaluable. I do not see any danger that can arise from their employment. They are Mahommedans, and are therefore more civilized than the natives of the coast, and are very much tied together in consequence. I think they might be made to form a part of, if not *the* regular Army, of that protectorate or confederation as well as at Lagos. Let us try the experiment, if you please, all along from Cape Palmas to Fernando Po. With regard to having small fortifications, I think perhaps some of the natives near the forts might be taught to fortify their villages; but if we are to do anything in the way of fortification for protecting our coast, we should have them within a circuit of a very few miles, and, if necessary, it might be done with small earthworks. I think, perhaps, the Gatling gun would be too difficult for the natives to work; but I am quite confident the Houssas and others might be very well taught to work small mountain-guns or camel-guns. Our prestige on the coast of Africa has gone down extraordinarily. We have put a stop to slavery, and the result is now we are not holding up our heads, and judging by what I can read and from what I saw when I was out on the coast some years ago for $3\frac{1}{2}$ years, I feel this about it, that nothing can possibly be more wrong than the uncertain state in which we leave these unhappy natives as to protectorate, confederation, and so forth. I think we should let them understand that we have a very small belt round our sea-ports which we absolutely will defend to the death; but that we will help them with ammunition and occasionally with money, and with military tuition to keep up the confederation I spoke of. And I would go so far as to flatter the great Kings and Chiefs by giving them at least something to say in the assembly or council in the large main towns at the head of the confederation. If these men are left outside in the cold till some one comes and attacks them, and are not allowed to combine together without getting into a scrape for it, the chances are our prestige must go, and before the public know it, we shall have the whole country covered with blood (as it really has been for a long time) and entirely devastated, unhappy children carried into slavery, and nearly all the old people slaughtered. I think what would be a useful thing (and I do not know that such a thing exists on that part of the coast) would be that each protectorate should have provided for it a very small steamer, not necessarily a man-of-war steamer, but one possibly belonging to the colony. It could lie with very great safety off Cape Coast Castle, and it might move about from one part to another for the purpose of carrying supplies, and enabling the Governor to visit the different parts under his protection.

Colonel YONGE, late 1st West India Regiment: When I went out to take the

command of the troops on the West Coast, my command reached from Gambia to Lagos, and then they made me an Administrator-in-Chief. I know Colonel Harley and Captain Glover, and I heard the name of that gentleman long ago—he is bearing a high character in that part of the world—but we are not allowed to assist each other. If they choose to protect the base, it can be done easily enough; but I do not see that any gentleman yet has replied to your Lordship's question—which is the best way of protecting this part of the world? My idea is, if they intend to do it, that they should have a couple of thousand men well officered and well commanded, and who should not be sent out against their will, but should be volunteers, and you will find more than 2,000 men who would be willing to go. They ought to be well paid for it; it is very hard times that men should be serving there and scarcely be able to live. I was utterly astounded when I went back, to discover that it had been proposed that our canteen should be taxed. Are we not only to pay in person but also in purse? I was delighted, however, to find that such a sum of money would be allowed to each Officer as would counteract the attempt made to put a tax on what we had. When Mr. Monsell was the Under Colonial Secretary, I said to him, "Now, Sir, I seek the appointment as "Governor-in-Chief of that place, and if you, having appointed me, were to ask me "to-morrow what I thought about it, I should say, remove us all away, both civil "and military." I know very well how the merchants thrive there. Look at Lagos; look at Benin. I was there; and there they are more prosperous than we are where we have our own force, at Sierra Leone. I asked Mr. Monsell what good it could be to the merchants of England to be charging them on imports and exports to the amount of £50,000 a year. I therefore agree in saying that I do not think we have any business there; but if you intend to protect those States, do it effectually, for it is a great shame that we should mislead these people and pretend to protect them when we do not. I think 2,000 volunteers, well paid, with four of Her Majesty's ships working down the coast, would do the work. These ships might go to the Canaries, to Teneriffe, here and there, even to that beautiful island of Fernando Po, where fellows can go to amuse themselves and recruit. Then you must have good weapons, if you are going to do it at all. When I went to Sierra Leone, the first thing I did was to go to an old friend of mine, then Deputy Adjutant-General. I said, "I am going to Sierra Leone, and I am entitled to have the very best weapons "you can give me." He said, "You are right." I had no occasion to use them, but I showed the natives the effect of them, and it prevented their going to war with the French up the rivers. I was then Administrator-in-Chief, and they came to me and threatened war. I said, "Nonsense, if you are wronged, appeal to the justice "of the Emperor, but don't you go to war with them, or you will be eaten up," and I showed them the effect of these guns. The giving me those guns brought honour to our country, for it so happened that by their use 40 men turned aside something like 500 men in the Orange country. A young gentleman came to me with a letter of introduction, and asked for the guns. He used them successfully on that river, and I am delighted to say he has been promoted from a subaltern to a Captain for his good service—a most unheard of occurrence.

Mr. Law: I was on the Coast last year, and with reference to the question how we are to attack Ashantee, my idea is that we should go up the Volta. I have been up the Volta with the late Captain-Governor Administrator Saber. We steamed 120 miles. It has not been thoroughly surveyed. Captain Glover led an expedition in the year 1870, but they had a good deal of fighting, and there were 300 or 400 men killed. We can steam up the Volta within 60 miles of Ashantee. It is a beautiful open country, with large plains and immense trees. If we attempt to go up as we did originally in the expeditions of 1862 and 1865, to cross the Prah and go up there, it is next to impossible, because the pathway is so narrow that the men have to go up in single file, and it is next to impossible to take a great force up; but if the Volta is explored I think we can do it. There is only one fort at Cape Coast Castle, Fort William, which is of any use. There is another fort there, but it is of no use whatever; it is a mere outwork. But there are other hills on which forts can easily be placed. At Elmina, there is the best fort that we have on the Coast, and the guns are the best guns; ours at Cape Coast are not to be compared to them; in fact our guns are old and useless, both at Cape Coast

Castle and Fort William. Another error that I noticed, my Lord, is with regard to the rifles supplied to the natives out there. All the natives have been able to purchase the Snider rifle since August, 1870. I have seen them myself sold in the different stores by merchants, with 100 rounds of ammunition, for £3. Major Rose was with me at the time, and remarked it. I said, "I am astonished "at this; what can we do?" I may also say as to the cause of the war, I believe the Dutch have always paid a fief to the King of Ashantee; and not only that, but I believe it is a fact that they have paid so much for every slave. Another thing that has brought on this war is that the King of Ashantee thought he could cope with us, and he had very good reason for thinking so, for his uncle was allowed to overrun our territory in Chopo and to commit unheard of atrocities. He ought to have been put to death the moment we seized him; but no, he was sent out, and allowed to pass free and unmolested. As to the ammunition, I have heard that the ammunition supplied to the Fantees was in great measure bad, and I have every reason to believe it, because I have seen it. Our ammunition that we had there has been there for years, a great deal of it. Hundreds of barrels were more or less damp, and I believe they were supplied with this ammunition.

Rear-Admiral Sir JOHN HAY: Can you inform us what was the draught of the steamer in which you went up the Volta?

Mr. LAW: I went up in the "Nelly;" I think she drew 6 feet.

The Earl of LAUDERDALE: In replying to the remarks which have been made during the discussion, I would say that four men will carry a Gatling gun quite easily, and the carriage can be carried by four more, while the ammunition may be carried by any number behind. I do not see any objection to the West India regiments, only I believe that these Houssas, whom you get on the spot, and who are acclimatised, would be the best. Captain Rogers also referred to a reserve of regulars; does he mean a reserve of the West India regiments? (Captain ROGERS: A reserve of the West India regiment.) Mr. Swanzy spoke of the famine that is certain to ensue. I am quite aware that that is a most serious point. These four tribes are now losing the season for sowing their crops, and they will be starving. There is no doubt that the Government will have to send out provisions. He also remarked that our Government underrate the numbers of the Ashantees, and I believe that to be perfectly correct. I have no doubt you can get up the Volta, but that is the only river, and it is rather a roundabout way. I am quite aware that the ammunition supplied to the Fantees was bad. With reference to Captain Beamish's remark that we could not defend the whole coast, the territory I am alluding to is only that between the Volta and the Assinee, the whole length being 250 miles. It is said that the proper plan of organizing these tribes would be a confederation. A confederation has already been tried, and it is approved of by our Government. The tribes did form a confederation, and laid down rules and constructed their Government, but they had done it without the sanction of the British Government, and the British Government threw it over. Not only that, but they put the leading men in prison. Still, I quite agree that the confederation would be one of the first steps, but it must be a confederation under the sanction of the British Government. I think another gentleman said that he did not agree with me about a protected territory, and that it is very different from a colony. I do not see the great difference between a territory properly protected by the British flag and a British colony. Perhaps he is aware that the Ionian Islands which we held for so many years, were not a British colony, but were nothing more than a protected territory. They had their own Government, a Government formed for them by us; but if any nation attempted to look at the Ionian Islands, while we held them, or attempted to hold up a finger to go that way, why we would have defended it to the last man we had. We laid out thousands of pounds in building fortifications; this was nothing more than a really protected territory; and when we take it upon ourselves to protect any territory, to say that we will protect them, to give the name of the British Government, and to allow our flag to be hoisted, I consider that we are quite as involved in protecting them, as if it was one of our colonies. Colonel Yonge gave us very valuable information. He thinks that the people that are not under our flag are more prosperous than those that are. That is not a question that I enter into. So long as we

have protected territories we are bound to protect them. One of the objections to the confederacy was, that of course you cannot have a Government without taxing the people to pay your Government, and then as we tax them again, these poor unfortunate people would be doubly taxed. If there is any confederation, we must be at the head of it, so that there shall only be one taxation.

The Chairman: I think I may safely ask the meeting and the Institution to give their best thanks to Lord Lauderdale, for his kindness in coming here. The subject is one of great interest, and Lord Lauderdale has taken it under his protection, and has ventilated it very well. We must also thank those gentlemen who have kindly taken part in this discussion.

Evening Meeting.

Monday, May 12th, 1873.

Lieut.-Gen. Sir FREDERICK CHAPMAN, K.C.B., R.E., Inspector-General of Fortifications, in the Chair.

NAMES of MEMBERS who joined the Institution between the 22nd April and the 12th May, 1873.

LIFE.

Sawyer, W. H., Lieut. 43rd Regiment.
Harston, C. G., Lieut. late R.M.L.I.

ANNUAL.

Johnson, Cecil F. W., Commr. R.N.
Richardson, J. S., Lieut.-Col. N. S. Wales Local Force
Powell, C. F., Lieut. Bengal Staff Corps
Fenwick, N. E. de B., Lieut. 60th Rifles
Wallace, N. W., Captain 60th Rifles
Beresford, G. D., Major Madras Staff Corps
Crawfurd, H. J., Lieut. Gren. Guards
Shute, Neville H., Col. late 64th Regt.
Fagan, C. S. F.. Lieut. R.M.L.I.
Hawes, A. G. S., Lieut. h.-p. R.M.L.I.
Goold, H. H., Major late R.M.L.I.
Craufurd, C. W. F., Lieut. R.N.
Ray, A. E., Major 3rd Middx. Art. Volrs.

FIELD RAILWAYS, AND THEIR GENERAL APPLICATION IN WAR.

By Captain C. E. Luard, R.E.

Sir Frederick Chapman and Gentlemen,

Since Captain Tyler lectured in this Institution ten years ago, I am not aware that the subject of railways has been again introduced, and it seems perhaps rather strange that such should be the case. It therefore is scarcely incumbent on me to offer any apology for endeavouring to condense into an hour's lecture a matter abounding in details, gaining in intricacy every day, and in which our country was the first to take the lead, and to plant its great railway works over the face of the globe.

As nations advance in civilization, it naturally results that their scientific knowledge gradually expands, and this advance in scientific knowledge is, or ought to be, demonstrated as much by the science of war, as in more peaceful pursuits.

Among the many changes science has produced in the art of war, there are probably none greater than those which result from the application of railways to military purposes. So highly indeed is their value considered in the present day in developing strategical combinations, and in furthering schemes which would formerly have been

impracticable, that it has been said with great truth, that whilst the due use of railways do not relieve a military man from the general studies which are indispensable to him, they constitute to an able man an additional arm, and impose on him fresh duties.

The wars in which railways have been more prominently used, are, firstly, the Crimean, concerning which the time at my disposal does not allow of my saying much. The railway from Balaclava up to Sebastopol was only about 5 miles in length, and though looked on at the time as rather a marvel, and introducing quite a new element into war, yet at the present time it would be considered a very unsatisfactory makeshift. It, however, gave a good deal of trouble to make. Commencing at Balaclava it was worked by a locomotive for about 2 miles; at this point the locomotive was detached and the train was worked up an incline of 1 in 15, and about $\frac{1}{3}$ of a mile long, by means of a stationary engine which rose eight waggons at a time; on arriving at the top of this incline, six horses were attached to each pair of waggons and took them up an incline of $\frac{1}{25}$ for about $1\frac{1}{2}$ mile to the Col de Balaclava. From that point, the line was pretty level, but there were two gulleys to be crossed, and these were crossed by the primitive method of detaching each waggon in succession and making it run down one side and run up the other side of the gulley by its own gravity; when there, horses were again used, and so the munitions arrived at Forks Depôt, the terminus of the line.

The line was constructed by English contractors, and was worked by Land Transport Corps, though attempts had previously been made to work it with the Army Works Corps and civilians, an ill-trained, ill-organized, unruly lot whom the Director of Transport was obliged to summarily dispose of, to enable him to get the work done. The work at first comprised the daily transport of about 200 tons of material, but ultimately it amounted during the last bombardment, to about 700 tons a day, to do which, the line was worked day and night for several days with about 1,000 men, of whom 400 were Turks. Having had the advantage of conversing on these points with Major Powell, the Officer who directed the transport at that period, and I believe during the whole life of that railway, I am able to submit these facts to the consideration of the members of this Institution.

The next European war displayed a considerable advance. The French poured troops into Piedmont by railway with great rapidity and regularity so as to conduce very much to their success in the campaign, and on one occasion (Montebello), the allied army was augmented during the progress of a battle with troops brought up by railway. The Austrians did the same at Magenta. But if we were in possession of all the details of the management and application of railways during the Civil War in America, there is more in that great struggle from which we might learn their use, their construction, and their destruction, than even from the last great European wars. I will take the liberty of extracting from Major-General McCullum's Report a few notes which will be generally interesting. From the very commencement of the war, railways were in constant use; the tracks (as they were termed) were laid, destroyed, and re-laid, and bridges were built, destroyed, and

re-built with a celerity which appear almost marvellous. But matters were done on a large scale then. It was not, however, till nearly a year had elapsed, that it became apparent to the Federal leader that the organization of a Construction Corps was of paramount importance. The corps numbered at first about 400 men, and expanded gradually to about 10,000. The design of the corps was to combine a body of skilled workmen in each department of railroad construction and repairs under competent engineers, supplied with abundant materials, tools, mechanical appliances, and transportation. They were formed into divisions, gangs, and squads, in charge respectively of supervisors, foremen, and sub-foremen, furnished with tents and field equipment; and store-houses were established at principal points with an ample stock of tools and materials.

The general charge of the railways for the department of Tenessee, was taken up very vigorously, and the general manager subdivided his department at once under a general superintendent for transportation, and a chief engineer, giving extensive powers to each.

The former department had—

1st. To conduct the transportation, and manage the movement of trains.

2nd. To maintain the roads and structures, and keep in repair the roadways, bridges, &c.

3rd. To maintain the rolling stock, and manage the fitting and repairing shops.

The latter department was organized in six divisions, and mustered at its maximum strength about 5,000 men. To give the corps entire mobility, enable it to move independently, and perform work at the same time at widely different points, each division was made a complete whole in itself and equipped complete, in order that the whole or any part of the same, might be moved at once in any direction when ordered, and by any mode of conveyance, by rail, with teams and waggons, or on foot.

Their organization is given in the Appendix A; each corps mustered 777, all told; giving for the six divisions, as I have said, about 5,000 men.

As an example of rapidity in execution of work, I may mention the Chattahoochee bridge, 780 feet long, and 92 feet high, *which was completed by the Construction Corps in 4½ days.* The Confederates gave the Federal Construction Corps plenty of employment, for in October, 1864, General Hood passing round Sherman's army, fell upon the railroad at Big Shanty and at Resaca, and destroyed 35½ miles of track and 455 lineal feet of bridges; but in *thirteen days*, trains were again running over this line.

On another occasion, 25 miles of track and 230 feet of bridges were reconstructed in 7½ days.

On another occasion, General Wheeler destroyed 25 miles of track between Chattanooga and Knoxville.

During General Hood's occupation of Tennessee, in December, 1865, all the bridges were destroyed; their repair was commenced in January,

1866, and by the middle of February 2,200 feet of bridge was rebuilt, and the line re-opened for traffic. During the succeeding winter, these bridges were many of them swept away by floods—some of them three times—and rebuilt.

It was the opinion of General McCallum that their success was founded mainly on the admirable though somewhat terse orders issued from the Adjutant-General's office, which were as follows:—

Commanding Officers of troops along the United States military railroads will give all facilities to the Officers of the roads and the Quartermasters for unloading cars so as to prevent any delay. On arrival at depôts whether by day or night, the cars will be instantly unloaded, and working parties will always be in readiness for that duty, and sufficient to unload the whole train at once. Commanding Officers will be charged with the guarding the tracks, sidings, wood, water-tanks, &c., within their several commands, and will be held responsible for the result. Any Officer neglecting his duty in this respect shall have his name struck off the roll of the army.

No Officer, whatever may be his rank, will interfere with the running of the cars as directed by the Superintendent of the Road. Any one who so interferes will be dismissed from the service.

Without this order the whole railroad system, which proved an important element in conducting military movements, would have been not only a costly but a ludicrous failure. The fact should be understood that the management of railroads is just as much a distinct profession as is that of the art of war, and should be so regulated.

It requires no apology, for me to quote further from General McCallum, as follows:—The men were continually exposed to great danger from the regular forces of the enemy, guerillas, &c., and owing to the circumstances under which military railroads must be constructed and operated, what are considered the ordinary risks in civil railroads are vastly increased in military lines. Hence the difference between civil and military railroad service is marked and decided.

The hardships, exposure, and peril to which train-men especially were subjected during the movements incident to an actual campaign were much greater than those endured by any other class of civil employés of the Government—equalled only by that of the soldier while engaged in a raid on an enemy's country. It was not unusual for men to be sent out for five or ten days with no sleep but what they could catch on their engines while being loaded or unloaded, with little or no food, while at the same time occupied in a manner which strained every faculty. Their railway organization became at length, *i.e.*, after about three years of war, so good as to enable the Federals to supply General Sherman's army of about 100,000 men (60,000 horses) with supplies from about 860 miles distance, by one line of single track railroad, located almost the entire distance through the country of an active and vindictive enemy.

The attacks on the line in rear of Sherman's army were of such frequent occurrence, and often of so serious a character, that to insure speedy repair it became necessary to station detachments of the con-

struction corps at various points along the road, and also to collect supplies of materials, such as iron rails, chairs, spikes, iron ties, and bridge timber, at points where they would be comparatively safe and easily obtained when required, and construction trains were kept ready loaded with tools and materials at each end of the road to move at a moment's notice. As an instance of their capacities of transport, General Hooker's corps, of 23,000 men complete, was carried from the Rapidan, in Virginia, to Stevenson, in Alabama, a distance of 1,250 miles in seven days.

The greatest number of men employed on railways at any one time	24,964
Length of railway opened and re-opened	642 miles.
Bridges built or rebuilt	26 miles.
Number of engines employed	419
Ditto cars ditto	6,330

The net expenditure was thirty million dollars, but the question then was not how much will it cost? but can this work be done at all at any cost?

Now in this civil war there are many points in connection with the railway management which are worthy of observation. In the first place you will observe that from the very commencement of this war, the Federals began to pay great attention to the subject, but that it was not for some time that they appreciated the paramount importance of carefully organized and disciplined corps. Secondly, the rapidity and facility which, with the assistance of these corps, they were able to maintain their railway system, and place thorough dependence on it; and, thirdly, the large number of men they found requisite to employ on the service.

The next war which showed the value of railways was the so-called seven weeks' war between Prussia and Austria, of which some notes were taken by Major Webber.

It appears that in advancing over the railways which had been in possession of, or had previously belonged to, the Austrians, the Germans employed, as part of the field railway department, a detachment organized as follows:—

It was partly military and partly civil.

The military were—

1 Colonel, 1 Lieutenant of Engineers, and 50 Non-commissioned Officers and men of the Pioneers.

The civilians were—

1 Head railway engineer, 2 Under ditto ditto, 6 Foremen, 2 Machinists, 1 Telegraph official, and 2 Locomotives and 30 waggons and trucks were placed at their disposal for penetrating into the country to be explored.

On the train were carried—

2 trolleys, and 6 light covered carts, viz:—

1 for Colonel Commanding, 1 for Lieutenant of Engineers, 1 for head engineer, 1 for two engineers, and 2 for nine sub-officials.

These carts were intended for use (if it was necessary) to march by road, &c.

The pioneers, who were exclusively carpenters and smiths, were armed and equipped in the usual manner.

This detachment carried 250 yards of permanent-way plant, and some materials for bridging. This section was attached to the 1st Army Corps.

The reconnaissance starts with, and until interrupted, keeps up with the advanced guard, the movement being covered by cavalry scouts on each side of the line.

The greater portion of the train in charge of the department, with one engine in front and another behind, advances slowly, preceded at a distance of about 500 paces by a trolley, carrying one of the Officers, four men to work it, and a bugler. On arriving at any obstruction the trolley signals to the train by bugle, and extra caution is used in advancing towards it. If in presence of the enemy, the scouts give warning to the Officer in the trolley, who returns to the train, and the whole retires. The second engine can be detached to the rear with messages or for fresh supplies.

I cannot wait to discuss this campaign, but the Prussian arrangements worked admirably till the bridge at Lobkowitz was destroyed, which broke the line for eight days.

The conclusions arrived at by Major Webber were very much to the point. Two things, he considers, are very important, viz., the creation of obstructions, and their removal. And the Officer in charge of this must be immediately in communication with the Commander-in-Chief, so as to be made aware of the nature of the proposed operations in order to be prepared for all emergencies.

He must also have a thoroughly organized and well trained corps under him.

In the construction of bridges, the Prussians had ample supplies of timber for repairing bridges, and this might generally be anticipated.

In this war, the Prussian field railway department was employed in the restoration of the lines, the working of them being immediately taken up by the railway officials, the Austrian staff of under employés remaining in their places, and the traffic of each station managed by an Officer of the Quartermaster-General's department.

There were three departments engaged, but they were all under military discipline. If the state officials and Austrians had not been available, the lines could not have been worked without a special staff; but armies invading a foreign country might meet with none of these facilities.

We now arrive at our own last little war, that of the expedition to Abyssinia; and I will take the liberty of abstracting the following observations from Lieutenant Willans' able report, on the subject of the railway there constructed:—

It does not appear to have been anticipated to do more in the first instance than to lay a short tramway between the landing-place, wherever it might be, and the depôts a short distance from the shore, but as soon as it became known that the Sooroo Pass would be the main route to the Abyssinian highlands, it was decided to construct a railway from Zoolah to the foot of that Pass, and in November orders were sent to Bombay for the necessary plant. It arrived in driblets, together with the platelayers, previous to which the work of grading had been zealously carried on by the troops, and small portions had been laid by them also. There was a good deal of difficulty encountered by those who had to make this line, as it had to be made through a timberless country, and the plant which arrived from Bombay was not always packed with discrimination; for instance, rails would come in one ship, and spikes in another, and sleepers in another, one of which ships would perhaps go astray, or be unable to be discharged at the same time as the others. The artisans of the 23rd Punjaub Pioneer Regiment had actually to make augurs to bore the holes in the sleepers."

In the middle of January they were able to form two trains, which for some time had to do all the work of the army as far as the line was completed, and so great were the demands on the two landing-piers at first, that it was with the greatest difficulty the railway plant could be unloaded; at the same time organized gangs of coolies arrived, but the Chinese were the only men who were really useful, the natives not being physically strong enough for the severe work required.

By the end of January, about 4 miles of line were completed, and the entire line of 11 miles, with a mile of sidings up to the Koomaylee terminus, was completed by about the end of April.

The rolling stock consisted of four engines and sixty waggons, which, though severely taxed, did the work throughout; and from the middle of May to the middle of June, of conveying from Koomaylee to Zoolah the whole of the troops, stores, baggage, and itself. The rolling stock was of inferior order, mostly old contractors' stock, requiring an immense deal of repairs and constant anxiety. The best locomotive could only draw fifteen small loaded trucks (perhaps 40 tons) up an incline of 1 in 60.

The waggons or trucks were springless trolleys, with cast iron axle bearings, and no grease-boxes, and the driving sand caused them to be continually worn out; of the sixty trucks about twenty-four were always under repair or unfit; the rails which were sent were of no less than five different patterns, and when they arrived it was found that in some cases the holes in the rail-ends and in the fish-plates were not placed at uniform distances, so that they could not be properly bolted together; they varied from 30 lbs. to 65 lbs. a yard, but the lighter rails were only of use for sidings. It was the opinion that the smooth travelling on the heavier rails, and the ease with which it was kept in repair compensated for the increased trouble and delay in laying. There were several bridges, the widest of which was about 72 feet.

The ruling gradient on this line was 1 in 60, and the maximum curve had a radius of 870 feet; the earthworks were comparatively slight; the gauge was the Indian 5′.6″ gauge.

The 12 miles took about four months to make, and this may seem longer than ought to have been the case. I confess though that the case appears to be, that with the difficulties which had to be encountered, it is remarkable that it was made at all, and when made, that it did its work effectually.

The process of laying the lines after the grading had been completed was as follows:—

The plate-layers were divided into 4 parties (See Appendix B.), and totalled about 150 men, of whom 43 were skilled, with parties of labourers, averaging 120 men, for carrying plant and unloading trains; with the light single-flanged rail, the rate of progress, when no delay occurred, was about 400 yards a-day, and with the heavy double-flanged ditto, with chairs, it was about 250 yards per day of ten working hours.

The civil establishment for working the line consisted of 1 storekeeper, 4 engine-drivers, 5 firemen, 3 station masters, 6 guards, 5 clerks, 3 railway telegraph signal men, and 12 pointsmen and signal men, and at the repairing shop there were—

1 locomotive foreman.
6 fitters.
3 boiler makers,

And about 50 native mechanics.

There were some difficulties about repairs. A very complete fitting shop was sent, but it was never put up, for although probably very carefully packed at Bombay, these arrangements were altogether neutralized by the vessel going ashore in the Red Sea, and her cargo having to be transferred to another ship, when it was distributed anyhow.

The remarks about the civilian staff are especially valuable, and I quote them in full:—

" The civil establishment picked up in Bombay at a short notice, and " without increased rate of pay being offered to them, could scarcely be " expected to give satisfaction, although in some instances we met with " valuable service. Some of the employés were dismissed, and their " places supplied by promoting those who seemed deserving men. We " lost through casualties and dismissal about 25 per cent. of the Euro- " pean civilians, and they were always a source of trouble and anxiety " to us, and Lieutenant Willans is of opinion that in future it would be " advisable to substitute for them, as far as possible, men from the " ranks.

" Intelligent non-commissioned Officers would make good station- " masters, as their most important duty is to obey orders. Guards " would be furnished in the same manner. Pointsmen and signal-men " could easily, if required, be supplied from the ranks. Engine-drivers " and foremen plate-layers were almost the only men whose places could " not be filled from the Army and Navy. Firemen and fitters can be " supplied from the latter, and for some time the duties of locomotive " foreman on the Abyssinian Railway were efficiently performed by " one of the Engineer Officers lent from H.M.S. 'Octavia.' The

"temperature under which the work had to be carried on at the "close of the Expedition seems quite appalling, sometimes up to 180° "Fahrenheit."

War is a difficult game to play, and the construction of this railway in war was, under the circumstances, most difficult. I highly honour, and I think that too much credit can scarcely be given to those who successfully carried out this work, small and insignificant as it may seem beside those in the great European and American wars.

German War.

We have now arrived at the year 1870, in which the struggle took place between the Empires of France and Germany for the possession of the Rhine frontier.

Much as I would wish, I cannot stop to comment on the remarkable events which then took place. Both sides started with considerable experience of the working of railways, and poured their troops and supplies on to their frontiers with all speed. We know that in a fortnight from the date of the order for mobilisation being given, the Germans placed 15 *corps d'armée* complete on the frontier, and did it methodically, so that everybody arrived at the right place at the right time, whereas the French sent everybody labelled *à Berlin*, and much confusion resulted when they arrived at the terminus of the line. The German organization appears to have been more perfect throughout than that of the French, and the results were consequently more successful; of course they had had more recent experience, which is more valuable than all theorizing, and they played throughout with winning cards.

I cannot do better than recommend those interested in the subject to peruse the "lessons" learned by Colonel Jacqmin, from his experience in the working of the railways in this war, reviewing, as he does in his able work, their ministration on both sides.

His conclusions are, that it is necessary to bear pre-eminently in mind two things:—

1st. Unity of command in everything which concerns the employment of railways, whether for the transport of passengers or goods.

2ndly. The association of the military and the technical element, a permanent association acquainted with all the phases of the railway system, so that, before giving an order, one might depend on its being possible to execute the order and that the results would not be as unfortunate as have been described, or which others may have to describe.

Practically, it seems easy to develop this programme by the adoption of the following measures, which form three distinct groups:—*General Measures—Purely Military Measures—Technical Measures.*

General Measures.—To establish, at the Ministry of War, a permanent Military Railway Committee, similiar to those of Artillery and Engineers. The committee to be composed of a General Officer as president, three superior Officers of the Staff, the Artillery, and the Engineers; a superior functionary of the intendance; a superior functionary of the public works department; six directors of the principal railway companies.

The Military Committee would concentrate at Paris all the information relative to French and foreign railways, and their employment in time of war.

Its action would extend over the whole of France, by means of Commissions of Ways and Means, each of which would be composed of an Officer and a representative from the railway companies.

Purely Military Measures.—To revise and simplify the previous regulations for the transport by railway of troops and material.

To take steps to ensure on their journey the provisioning of men and horses.

To instruct all the troops, as a part of their duty, in the best mode of getting in and out of trains, and loading and unloading military *matériel*, whether at the stations or out anywhere along the line. This to be considered, and to be on the same footing as drill. To include, in the duties of cavalry, the defence and attack, at great distances, of the lines of railway, for which they should be provided with a special stock of tools.

To distribute maps freely, and encourage the study of geography and topography.

Technical Measures.—To complete, in a certain number of stations, the means of utilising the platforms and docks, by the construction of ramps.

To include, in the time-table of each company, a certain number of trains arranged in accordance with military requirements, and which could be used on the receipt of a despatch.

To create 10 or 12 military field companies, analogous to those of Germany, whose duty would be to repair the lines or other works destroyed by the enemy.

To connect the arsenals and the military establishments with the general network of railways, especially where such connections do not at present exist.

To construct special works outside the towns, for protecting the tunnels, viaducts, branches, and other important railway works.

Jacqmin's opinion is that the civil railway staff should be associated with the military element, and his views are being at the present time carried out in France. The detail of the composition of the new Railway Committee just appointed, is almost precisely similar to that already quoted from his work, except that there are only two in place of six railway directors. Some very important arrangements have also been quite recently made in France to recruit for this department. The recruits of the French military engineers will be classified in three categories :—the first (two-thirds of the whole contingent for the year) will be incorporated in the active battalions, and will be instructed as sappers, miners, or as soldiers of the engineer train.

The second (one-sixth of the year's contingent) will serve one year only in the active battalions; it will then be distributed among certain of the principal railway companies, in order to learn the working and management of their lines, their construction, and restoration.

The third (one sixth of the contingent) will only serve one year in the active battalions, and will then be transferred to the depôts. These

will carry on operations with torpedoes and dynamite, &c., and be practised generally in the destruction of railways, bridges, &c.

A very similar organization of a military railway department has just been established in Italy.

Besides the constant work entailed on the German railway corps, there was one special work constructed in the neighbourhood of Metz, which merits a more detailed description than usual.

At the commencement of the war, says Rustöw, the Prussian General Staff had assumed that Metz would be able to hold out for a protracted space of time, and that it would probably break the railway communication between their armies and the frontiers of Germany, and they therefore decided to restore this by a field railway, and preparations were made for the same. On the 14th of August, the day of the Battle of Borny, the survey of the ground and the levelling were commenced by the military detachments; on the 16th the construction of the line was begun, and it was finished by the end of September. It was from Remuilly to Pont-a-Mousson, a distance of about 18 miles direct, the total length of the line being 36 kilometers, or say 22 miles, giving an average of about 1,000 yards a day. The number of men employed was about 4,000 a day, composed of two field railway companies (450 men), four fortress pioneer companies (800 men) and about 3,000 miners from the coal districts of Saarbrücken, temporarily out of employ. To assist them was a park of about 250 vehicles, and after a short time the 84 waggons of the pontoon trains of the 7th and 8th *corps d'armées.* The work was carried on at several points at once, and included two bridges over the Seille and the Moselle, and two viaducts. It is reported that the total weights to be transported, amounted to 8,750 tons, presumably of permanent way, or about 400 tons per mile.

The bulk of the line ran over a very easy country. Jacqmin says that the cuttings were only about 3 feet deep, and the embankments about 5 feet high, except near the viaduct, where they were about 10 feet. The viaducts and bridges were of timber, with spans of about 16 feet, the timber being obtained from tradesmen or cut down in the neighbourhood. The ruling gradient was 1 in 40, and the maximum curve about 10 chains.

In the last week of September it was tried with locomotives, though it was not actually worked till 4th October, but when the autumn rain came on, the track settled in many places, and almost as many workmen were obliged to be maintained for its repair, as had been necessary for its construction. The traction became very dangerous, and several accidents took place; at Morville it is said that an engine lay on its side on the rails for several days. During this period of 26 days, the working was of a very moderate description. The locomotive only drew four waggons at a time, and sometimes the four waggons had to be uncoupled. It does not seem in fact that the railway was particularly well constructed; it cost a good deal of labour, time, and money, and did practically no work, and the fall of Metz at the end of September, relieved the German engineers from their difficulties.

The railways had heavy calls on them to transport the wounded and the French prisoners to Germany, and the latter did not always fare well;

some of them being kept for three days in open waggons in intensely cold weather, whereby some of them were frozen to death.

On the French side, the organization of the railway department collapsed in consequence of the general annihilation of the armies; and there is no doubt that Bourbaki's ill-success in the east of France, was in a great measure due to the ignorance of railway management.

At one period indeed, there is little doubt that a well organized raid on the railway between Toul and Blesure would have had every chance of successfully interrupting for some time the main artery by which the supplies of all kinds were sent from Germany to the armies before Paris, and might possibly have led to the raising of the siege of that city.

I have taken the liberty of conducting you through the various wars in which railways have played their part, and the lessons that may be learned from them are many and various, and I have felt how utterly impossible it is for me within the limits of a single lecture, to enter into details as much as I should wish. There are innumerable points in connection with these matters which would be of the greatest interest and importance, as illustrations of the subject, on most of which one hour's lecture might profitably be expended. But the lesson I wish more particularly to impress on everybody is this, that without a recognized military railway department, war cannot be carried on against first class powers at the present time with any prospect of success; that against all nations, whether civilized or uncivilized, the application of railways as a branch of military operations advances with rapidity the conclusion of such war, and consequently repays its own cost to an immeasurable extent.

As an example of what the Russians are doing in these matters, Captain Burnaby has given an account in his lecture in this Institution on the practical instruction of Staff Officers.* In 1869, a Special Committee was appointed to consider all matters connected with railways, and the result has been, that all the Railway Companies have to provide a certain number of carriages for wounded, fitted up with litters and well ventilated, and a number of carriages, waggons, and trucks, specially devised for military purposes.

They have moreover, formed a railway corps in the following manner. Eight officers and 432 men were distributed among the various railways, the officers for instruction more especially in the duties of station-master, and the men in the management of the line. After two years' practice, it was decided to test this corps during the annual manœuvres; they were therefore suddenly recalled from their respective stations, and formed into two companies of four officers and 216 men each, each company comprising engineers, engine-drivers, stokers, guards, pointsmen, signalmen, &c. An infantry division, and an engineer battalion, were ordered to assist in the work. This force constructed during the manœuvres, a line of seven versts in length in seven days, including two stations and ten bridges, one of which was about fifty yards long.

The Italians had recently arranged that each battalion of engineers in their army was to be augmented by one railway company, besides

* See Journal, No. 68, Vol. xvi, p. 633 *et seq.*

which, all the companies of engineers received a brief education in that kind of work, and consequently the engineer committee had issued a manual of instruction in two parts, the one relating to the construction of railways, and the other to the destruction and repairing of lines, in addition to which, the corps of engineers actually work two small lines of railway. But the Italians were not satisfied with this, and, keeping pace with the age, they have detailed a body of officers of all arms of the service to study the organization and execution of railways on the North Italy Railway; when this course of construction is completed, the officers will be called on to prepare a complete practical manual for working railways from a military point of view, in order to arrive at the formation of a technical staff capable of undertaking the direction of the service of the railways in time of war.

The Director-General of the North Italy Railway has, in concert with three very senior officers of the army, recently submitted a report on the military service of railways.

This report has been published in the "Railway Monitor," an Italian paper.

It recommends the establishment of a General Department, for the military service of railways at the war ministry, or at head-quarters, composed of a certain number of officers of all ranks and all arms, and directed by a general officer; they will also undertake the general direction of military transport. The department will employ in peace-time any surplus officers for directing the office work, and superintending the practical instruction of officers on the lines of railway.

For the transport service, six captains and six lieutenants of engineers and artillery will be thoroughly instructed in everything concerning the service of depôts of material, the employment of each kind of vehicle, the registering of their various capacities, and in the course laid down for the service of the men and the trains.

Service of the Line.—In order to have skilled workmen for executing the special work appertaining to railways, there will be established a special school for technical and constructive works at the head station of the Northern Italian Railway Company in Turin.

The school is formed of a brigade of two companies of sappers; some officers and non-commissioned officers taken from the other companies of sappers, will participate annually in the exercises of this brigade.

As it is not possible to pass the whole of the sappers through this school, they will be exercised in analogous works on the line of railway near their respective stations, on the same system as that established at the school; the principal exercises will be the loading and unloading of railway plant, in plate-laying, working signals and improvising bridges, &c. Whilst the railway company will have to construct new branches, effect repairs to the way, and the points and crossings, &c., the brigade will be able to furnish a certain number of workmen habituated to assist in the execution of such works.

Besides the officers and soldiers appointed to familiarize themselves with the service of the line, there will be detailed annually for the special study of the organization of the service of the North Italy

Railway Company, twelve officers of engineers, half of whom will be captains, and half lieutenants; they will at the end of their course of practical instruction, present reports on the object of their studies, they will have to furnish projects on the improvements which appear to them necessary from a military point of view, on putting the stations in a better state of defence, in the destruction of artificial works, &c.

Owing to these works being prepared previously, the Minister will, at the given moment, have nothing to do but order their execution.

The service of the trains is not as easily prepared for by a military staff as that of the construction of the way, but if one is unable to rely on the mechanics, one can always withdraw the firemen from the technical brigade. In time of war, these latter could replace those of the company, being under military law, men who could, by reason of their great experience, be promoted mechanics for the working, more especially at those points of the lines most exposed to danger.

Recruiting of the Workmen for the Railways.—In the annual sub-division of the contingent, we should tell off for the railway brigade such men as have been employed on railways; these men on being discharged will pass into the militia, and if necessary can be recalled into the railway brigade, and will wear on their ordinary clothes a badge with the inscription "Railway Brigade."

They also consider it possible to organize in time of war, a corps entitled railway volunteers, drawn from the civil establishment of the railways, who will be subjected to military discipline. The nucleus of this corps can be prepared during peace by the Minister, the term of service being one year.

The other railway companies are to be organized in a similar manner to that of Upper Italy.

The report has been made chiefly with the object of adapting the military requirements in time of war to the ordinary service of the various railway companies.

To carry out these arrangements a special decree has been passed to the following effect:—

The Government will appoint a Military Commission to be attached to each of the chief railway companies in the kingdom, whose powers are fixed by royal decree. The Government also concur in the suggestion that the commission shall be composed of superior Officers of all arms, of two functionaries from the Ministry of Public Works, and of a superior locomotive superintendent from each of the great railway companies, who shall in peace time have a voice in the consultations regarding railway works, the permanent and temporary lines; in time of war, these commissions can be charged with the general direction of the railways.

The regulation of existing railways is a subject intricate in detail, abounding in statistics, and which must be left to the determination of the department, which must ere long be organized. Indeed, a provisional committee has, it is understood, been recently established to consider these matters, and it will be readily understood how much time and attention requires to be bestowed thereon.

I will therefore direct your attention more especially in this lecture to one special branch of the subject which comes very prominently before us Englishmen, and that is the construction of entirely new railways in time of war.

The first point that occurs to most people is what is to be the gauge of such railways. But the fact is, that gauge is entirely dependent on circumstances. In England our lines are, with hardly an exception, of the 4′ 8½″ gauge, and thousands of engines and many thousands of vehicles are available for use daily. It would therefore never be practically advantageous to construct lines other than of the ordinary gauge in our own country if she were engaged in war, within the limits of Great Britain. In Ireland the case is somewhat different, the gauge is 5′ 3″, and an unsatisfactory gauge it is in many ways, exceeding the requirements of the country, and carrying rolling stock bearing an undue proportion of dead weight to the quantities of goods, &c., transported, and which could not be supplemented from England in case of an invasion of that country. It is worth considering whether the Irish railways should not be assimilated in gauge to that of Great Britain, the rolling stock changed at the expense of the State under certain conditions, and the new rolling stock made of the patterns which may be considered most suitable to military requirements and equally advantageous for civil requirements.

But our last wars have been expeditionary wars, and the probabilities are in favour of such wars being those in which we are most liable to indulge in at present; it is therefore worth our while to consider and discuss what sort of railway we could best use to further this object and economize the cost of the expedition.

As you have seen, in the Crimea we took several months to make about 5½ miles of semi-railway semi-tramway; and in Abyssinia it took several months to make about 12 miles of railway, on which much difficulty was experienced in providing for the wants of an army of about 13,000 men.

The return on the 1st May, 1868, gives:—

$$13{,}449\begin{cases}501 \text{ Officers.}\\ 3{,}972 \text{ European troops.}\\ 8{,}976 \text{ Native troops.}\end{cases}$$

20,295 followers.
330 civilians.
2,538 horses.
40 elephants.

For the majority of most foreign countries, the gauge of the existing railways is also 4′ 8½″, and the same remarks which apply to our own country, apply almost equally to such countries. India is, unhappily, in a state of war at present, racked and wrecked with the everlasting battle of the gauges, and perhaps the less I say about it the better, for in the discussion which will, I hope, be introduced by this paper, it is not my desire to provoke a protracted discussion on a point on which so many people differ, and on which so many people have recently expressed their views at the Institution of Civil Engineers.

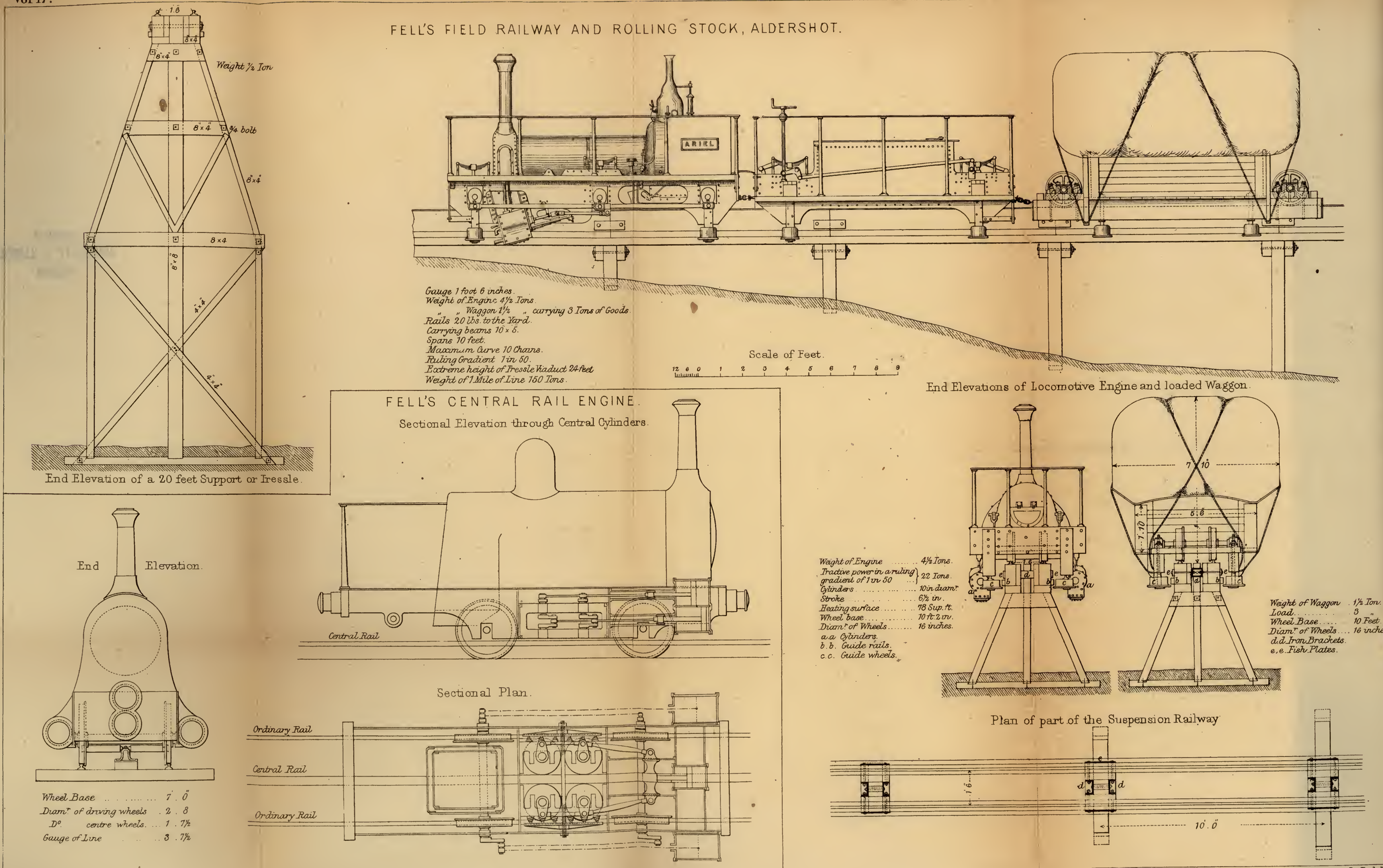
But so much has been said about the matter lately, and the study of our relations with Central Asia is being brought with such prominence before us, that I cannot refrain from observing that any railway extension beyond the mountain barriers of our Indian Empire, whether into Persia, China, or Russia, cannot be advantageously, or with any prospect of financial success be so extended on the existing 5′ 6″ gauge. In mountain lines the narrowness of gauge is of vital importance.

In the construction of a new railway in war, economy of men is of more consequence than economy of money, and economy of time is of greater importance than either. The point is therefore, what sort of railway can be constructed in the shortest time, with the smallest number of men. If it is expected that the troops of the line are to assist in its construction, there is one difficulty which we immediately stumble over, and that is, that the smaller the army, the less number of men can be spared for employment on works, and *vice versâ*, whereas the smaller an army, the greater is the average length of its daily march, and *vice versâ* again; therefore, if the construction of a railway has to keep pace with the march of an army, and I cannot consider the result to be satisfactory which does not effect this, it is in reality a matter of calculation whether it is possible to make a railway at all, and with what sized army? For instance, we know that for a very small body of men, no railway of however diminutive a nature would be of advantage, and if in an enemy's country could not be guarded, if of any length.

There are several railways of a diminutive nature now in use for special objects. At Crewe, in the works of the London and North Western Railway, in Woolwich Arsenal, and in Chatham Dockyard exist lines of only 1′ 6″ gauge; that in Woolwich especially, transporting enormous weights; the locomotive for it weighs six tons, and has a wheel base (*i. e.*, the distance between the axles) of 3′ 8″, allowing it to pass readily round curves of very small radius; these lines are all on the level, or nearly so.

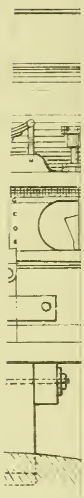
Another line of the same gauge has also been recently constructed at Aldershot as an experiment, under the auspices of the Royal Engineer Committee. This line, and more especially the rolling stock used on it, exhibit many novel features, and were designed for the War Department by Mr. J. B. Fell, the celebrated engineer of the Mont Cenis Railway, who also superintended its construction. (See Plate.) He has himself described it in a lecture given by him to the United Service Institution, at Plymouth; and I cannot do better than state very much in his own words, the reasons for his adoption of this form of structure, and the details of its construction:—

"If," says Mr. Fell, "the problem presented to us for solution is, "that of making a given length of railway, with a given number of "men in the least time, or the limit being fixed to the number of men "and time, to make the greatest possible length of railway, then it is "evident that the solution must be found principally in an improved "method of executing the earthworks, masonry, and ballast, or their "equivalents, since it is in these usually that more than nine-tenths of "the whole work consist.


FELL'S FIELD RAILWAY AND ROLLING STOCK, ALDERSHOT.
ARIEL
Gauge 1 foot 6 inches.
Weight of Engine 4½ Tons.
" " Waggon 1½ " carrying 3 Tons of Goods.
Rails 20 lbs. to the Yard.
Carrying beams 10 × 5.
Spans 10 feet.
Maximum Curve 10 Chains.
Ruling Gradient 1 in 50.
Extreme height of Tressle Viaduct 24 feet.
Weight of 1 Mile of Line 150 Tons.
Scale of Feet.
12 6 0 1 2 3 4 5 6 7 8 9
End Elevations of Locomotive Engine and loaded Waggon.
Weight ½ Ton
¾ bolt
End Elevation of a 20 feet Support or Tressle.
FELL'S CENTRAL RAIL ENGINE.
Sectional Elevation through Central Cylinders.
Central Rail
End Elevation.
Wheel Base ... 7 . 0
Diamr. of driving wheels ... 2 . 8
Do. centre wheels ... 1 . 7½
Gauge of Line ... 3 . 7½
Sectional Plan.
Ordinary Rail
Central Rail
Ordinary Rail
Weight of Engine ... 4½ Tons.
Tractive power in a ruling gradient of 1 in 50 ... 22 Tons.
Cylinders ... 10 in diamr.
Stroke ... 6½ in.
Heating surface ... 78 Sup. ft.
Wheel base ... 10 ft. 2 in.
Diamr. of Wheels ... 16 inches.
a.a. Cylinders.
b.b. Guide rails.
c.c. Guide wheels.
Weight of Waggon ... 1½ Ton.
Load ... 3 "
Wheel Base ... 10 Feet.
Diamr. of Wheels ... 16 inches.
d.d. Iron Brackets.
e.e. Fish Plates.
Plan of part of the Suspension Railway
10.0

J. Jobbins

RO



Goods.

" As there is no known method of executing earthworks, or of " building bridges and culverts, with greater expedition than that in " general use, and which simply consists in increasing the number of " men, the plan I have adopted has been to dispense with earthworks, " masonry, and ballast, altogether, or nearly so, and to substitute for " them a continuous structure of timber, upon which the rails are laid. " This method of construction renders it necessary to adopt an ex- " ceptionally narrow gauge, and the extremely narrow gauge necessi- " tates the introduction of peculiar arrangements into the locomotive " engines and carriages.

" The structure consists of a double beam of timber, resting on " timber supports sunk a very slight depth in the ground, and placed " at variable distances apart. The supports are made of a vertical " post and two side struts, resting on a sleeper, and connected at their " upper ends, by two cross pieces, which, together form a kind of " triangular frame, and furnish at once the carrying power and stability " necessary for supporting the weight, and resisting the lateral oscilla- " tion of the running of the trains; the beams are made continuous by " means of fish-plates at each joint, and are firmly secured by three " bolts passing through the centre part, and through the whole width " of the structure."

Experience shewed that where curves occurred these long bolts were not easy to manage, the bolt holes not readily coinciding; and an experiment is now being made in substituting iron brackets or boxes for certain of the wood fishes, and filling pieces, and bolting with quite short bolts. It remains to be seen whether they will answer, but they add much to the rapidity of construction. The structure consists in fact of two parts, the double beam and the supports, with the addition in the widest span of longitudinal struts.

The ruling gradient of the Aldershot line has been made 1 in 50, and the maximum curve a little more than 3 chains. On this the conditions were, that an engine not exceeding 6 tons weight was to draw a load of 30 tons. The builders, however, miscalculated, and made the engine only $4\frac{1}{4}$ tons: it has a rigid wheel base of about 10 feet, carried on three pairs of wheels, all coupled; the weight therefore on each pair of wheels, or on any 5 feet of the structure does not exceed about $1\frac{1}{2}$ tons. Its tractive power on the most severe part of the line is about 22 tons.

To overcome any tendency to upset, the centre of gravity of the engine has been carried as low as possible, and is in fact only 8 inches above the rails, the cylinders, as you observe, hanging down on each side of the structure below the level of the rails. Safety is furthermore obtained by what are termed guide wheels, *c.c.*; these are horizontal in position, hanging on spindles, attached to the sides of the engine and waggons, and rotate against the guide-rails whenever they touch the side of the structure, from which they are separated about half an inch or so; one pair are placed near each extremity of the engine. To still further ensure the stability of the engine, these guide-wheels are single flanged, the flange biting when necessary under the edge of the guide-rail.

"Consequently although the gauge of the Aldershot Railway is only "18 inches, it becomes by these special appliances, equivalent to a gauge "of 3′ 6″ by the additional 1 foot of lateral support, on each side of "the structure, given by the horizontal wheels acting on the guide "rails.

"The method of construction is as follows: A section having been "taken over the ground, and the heights of the rails above the surface "ascertained, the materials would be distributed along the line, suitable "supports having been selected from the stock of assorted lengths sent "out from England. A force of 400 to 500 men would then be sufficient "to construct a length of one mile of railway per day over an ordinary "country, with embankments varying up to 20 feet in height, and as "the railway is made it will carry forward its own materials from the "landing port into the interior, so that much less than the usual amount "of carting would be required. The erection of the structure would be "commenced at a number of points simultaneously, and be carried "forward in the two directions, until the different sections met, and in "this manner within a short period, an almost indefinite length of rail- "way could be constructed, reaching from the base of operations to "the rear of an army in the field."

Now this Aldershot line is probably of the narrowest gauge on which a locomotive engine could work, and Mr. Fell states, "That on a single "line of this description with passing places two miles apart, 25 trains "could be run in each direction in a day of 12 hours; and that, with a "ruling gradient of 1 in 100, each train drawn by one engine would "carry 40 tons of stores, and could thus effect the transport of 1,000 "tons per diem."

This 1,000 tons is the result of the following calculation: The provisions, forage, fuel, &c., consumed daily by a *corps d'armée* of about 22,000 men is about 200 tons, but this includes forage, &c., for a large amount of supplementary transport animals, which could be dispensed with if a field railway were used, and in that event the weight to be carried per diem would probably not exceed 170 tons.

Therefore, for 100,000 men the weight to be transported would be about 800 tons, and as it is improbable that England will ever have a larger army than this in the field, in any foreign war, 1,000 tons is probably the maximum that a field railway would ever have to carry in a day. I will therefore revert to the calculation of men required to make it. It is doubtful whether one could depend on a larger proportion than one-tenth of an army being available for employment in railway construction. Assuming that a railway, such as that at Aldershot, can be made at the rate of one mile per day with 500 men, and that whilst an army corps of 22,000 men could march on an average 12 miles a day, an army of 100,000 men could march only an average of 8 miles a day, it results that the smaller army corps could, with one-tenth of their strength, only make about 4 miles of line per day, whilst the larger army, with the same proportion of workmen, would have no difficulty in constructing daily its 8 miles or so of railway. On these bases, the calculation can be founded that an army of about 60,000 men could construct, with one-tenth of their strength, the same

length of railway per *diem* which would be the average distance that number of men could march, viz., about 10 miles, and that, with an army of greater strength, a greater length of railway could be, if necessary, made. These, like all calculations, are of course open to criticism, but I have no hesitation in recording my opinion that a railway capable of carrying all the munitions of war for an army of about 100,000 men could be constructed by it at the same rate at which that army could march.

I do not, however, think that it would be possible to do this, or anything like this, if the ruling gradient of the line be limited to 1 in 100, unless the country were singularly favourable, or if the radius of the curves was limited to 3 chains. But we cannot pick and choose the country in which our campaign may require to be undertaken, and if any considerable length of line were required, the topographical features of the country would invariably necessitate peculiarities of construction. If the gradients were limited to 1 in 100, or thereabouts, viaducts of considerable height would be constantly occurring in a moderately hilly country, and in a mountainous country, would be formidable works to construct, whatever material they may be made of. As portability is the essence of rapidity in construction, so should we avoid the use (in the first instance, at all events) of cumbrous and very weighty trestles. The 20-foot trestle, shown in the Plate, weighs half-a-ton. To enable this to be done, it would be necessary, in laying out the line, to study and to follow, to a great extent, the sinuosities of the country and the varying levels of the ground; and I think that if this were done, and much greater latitude given to the curves and the gradients than has been given to the Aldershot line, one might fairly calculate on being able to erect, with the necessary celerity, a given length of railway with a given number of men.

But, as the steepest gradient in a line of railway rules the load which can be drawn by any one engine, it consequently rules the gross load which can be transported daily on that line. Now, although 1,000 tons may be the maximum weight of stores which might be required to be transported in any one day, we must add to that the weight of the line itself, the whole of which would have to be deposited at the terminus of the line in time to enable the work of the following day to be proceeded with. This is something considerable. The Aldershot pattern of railway weighs about 150 tons to the mile on an average country, and if 10 miles of railway is to be made daily, the total weight to be carried daily would be about 2,500 tons. I have no hesitation in saying that I do not believe the Aldershot line capable of performing that work.

But increased power in the engine is in a great measure synonymous with an increase of weight, which necessitates heavier rails and increased strength of structure.

We will assume, then, that to do the work, a structure is required similar in principle to that at Aldershot, but weighing 200 tons in place of 150 tons to the mile, and that, consequently, the total daily weight of transport is about 3,000 tons. The problem, then, for consideration is, how is a load to be carried three times the weight of the

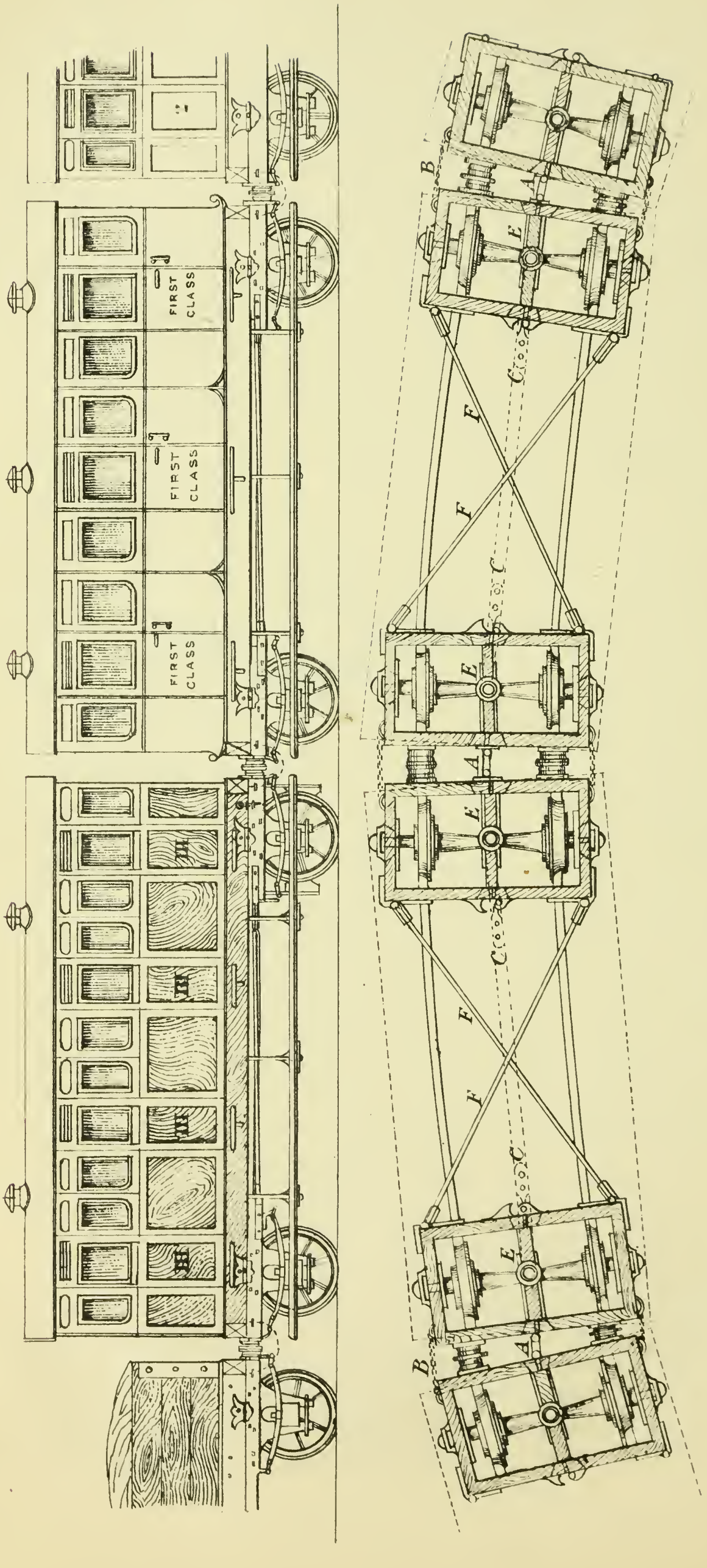
maximum capacity of the Aldershot line on a railway with steeper gradients and sharper curves than that line possesses ?

I believe that the most powerful engines that have yet been built for working on other than extraordinary gradients, are the "Fairlie" double bogie engines, the adoption of which, more especially on railways of unusually narrow gauge, has enormously increased their capacity for transport. On the Festiniog line in North Wales, which has a gauge of only $1' \, 11\frac{1}{2}''$, one of Mr. Fairlie's engines, the "Little Wonder," weighing about 20 tons, has drawn a train of 213 tons gross weight, carrying 144 tons of goods, over the steepest gradient (1 in 60) on that line without difficulty. The principles of these engines are chiefly that the fire-box and boilers are pivoted upon two separate platforms or "bogies," each resting upon two, three, or in some cases four pair of coupled wheels. The result is that the platforms adapt themselves to every sinuosity of the line, so that they may easily be traversing at the same time different parts of a reverse curve of short radius; and thus the length of the engine as a whole may be greatly extended, and any reasonable amount of power, that is, of boiler and fire-box surface, may be given to it. Furthermore, its weight is distributed over its eight, twelve, or sixteen wheels in a manner most favourable for adhesion. As the minimum radius of the curve round which an engine can run, must be proportioned to the wheel-base (in combination to a certain extent with the gauge of the line), this double-bogie arrangement has simplified the question of curves very much. The "Little Wonder," having a wheel-base to each bogie of 5 feet, can traverse curves of one chain radius with the most perfect ease.

For ascending steep gradients, the system adopted by Mr. Fell on the Mont Cenis and other lines, is one which gives very great increase of power; it is that known as the "centre rail," and Mr. Fell has been good enough to lend me some drawings of a locomotive illustrating that system, enlarged copies of which you see on the wall. (See Plate.) He provides his engine with horizontal wheels, worked by separate cylinders to those which work the vertical driving wheels, thus obtaining from one engine an extraordinary amount of adhesion, and enabling gradients to be ascended which were hitherto considered impossible. My impression is that an engine combining the double-bogie and the centre-rail systems, would produce the most satisfactory results, and that for a military field railway such engines would facilitate very much the work required to be done, more especially in steep descents, a third or centre rail being attached to the structure wherever the gradient of the line was necessarily steep.

We estimated that 3,000 tons was the weight required to be carried daily on a line to enable 10 miles to be constructed daily, and if we assume 25 trains as the maximum number per diem, each train must carry an average of 120 tons, but as one could scarcely depend on being able to load each train with exactly the same weight, I think we shall not be far wrong in fixing 130 tons as the maximum weight for each train. The "Little Wonder" drew 144 tons of goods on a gradient of 1 in 60, but her load was distributed in 77 little four-wheeled waggons weighing each with its load only $2\frac{1}{2}$ tons, giving very little more than half

THE "FLEXIBLE FOUR WHEEL" STOCK
(GROVER'S PATENT.)



Robt. J Cook & Hammond Lith. 29 Charing Cross S.W.

a ton of load for every lineal yard of the train. For military purposes such small vehicles would not be necessary, and would have many disadvantages. The weight on each axle rules, to a certain extent, the strength of the structure, and the greatest strain thereon would be caused in a field railway, by the engine; hence the weight on the axles of the waggons may be made to suit circumstances. Therefore if the gauge would have admitted of waggons containing 6 tons being used on the Festiniog line, the number of axles in the "Little Wonder's" train, which, by the bye, stood on several reverse curves, would have been 44 in place of 144, the total length of the train would have been about 120, in place of 240 yards, and, under those circumstances, she could have drawn a total net load very considerably exceeding 144 tons. You will, therefore, perceive that the nature of the waggons used for transport is a subject of the utmost importance, influencing the capacity of a line to a singular degree.

The capacities of waggons depend more on their width than anything else, and the safe width depends on the gauge. It has been found in practice that a waggon $2\frac{1}{2}$ times the width of the gauge will travel with perfect safety; the waggons in use on the ordinary English railways are not so proportioned, because in the first place, they would be unwieldy, and in the second place, it would make a serious difference in the width required for a double line railway.

On the other hand, in the Aldershot line, Mr. Fell's waggons manage to carry loads between five and six times the width of the gauge of the line. The waggon shewn in the diagram (see Plate XXXVI) was drawn at the tail of a train at a speed of about 15 miles round a curve, without any serious oscillation; it carried 100 tents, sufficient for a battalion of 1,000 men, and weighing a little over 3 tons. You will see that in this waggon the wheels are placed at either end, the body of the waggon being in a manner slung between them; by this means a very low centre of gravity is procured, the floor of the waggon being only a few inches above the level of the rails, but it has a rigid wheel-base of 10 or 11 feet, limiting the curve round which it can traverse to about 3 chains.

There is, I think, no doubt that a four-wheeled waggon is that best adapted for transport, and for giving the engine the greatest tractive ease, but the difficulty has hitherto been to obtain a short wheel-base with a good length of waggon, and yet the wheel-base should not be less than twice the gauge of the line. Mr. Grover has, however, produced an arrangement by which these difficulties are overcome, viz., by attaching hinged rods to the extremities of frames to which each of the axles is attached; these frames work on centre pivots under the body of the waggon, and by this cross-bracing each pair of wheels takes the exact line of the rails when on a curve, and the frictional resistance of the flanges of the wheels against the rails is reduced to a minimum. (See Plate). I would propose, then, to use for a field railway, waggons with a wheel-base of about 8 feet with cross-braced axles, the total length of the waggon about 12 feet, with a width of 7′ 6″; they should weigh about 3 tons, and have a carrying capacity of 9 tons.

The gauge of railway on which these waggons would be used, should be about 3 feet, and this gauge would be very suitable for a double-

bogie centre-wheel engine, weighing about 30 tons. The weight on each axle of a waggon would be 6 tons, and on each axle of an engine with four-wheeled bogies would be $7\frac{1}{2}$ tons. The wheel base of the bogie to be about 6 feet, allowing sufficient space between each pair of driving-wheels for the horizontal wheels. Such engines would, with waggons of the above description, take the required load of 130 tons up an incline of about 1 in 40, and a train, with two such engines attached, could surmount about 1 in 20. It is very rarely that steeper gradients than this would require to be encountered, if latitude be given for small radii in the curves.

It would probably be best to station at the extremities of the steepest inclines, a certain number of extra engines, which could be attached to the trains as they arrived and help them up and down. This rolling stock would also be able to traverse curves of one chain radius.

The quantities of rolling stock required for actually working the line would be 50 engines and about 500 waggons, and if we add one-fifth for rolling stock out of repair, it results that the quantities required would be 60 engines and 600 waggons. Beyond a distance of about 100 miles, they would have to be proportionately increased in number. Each of these waggons would have capacity sufficient to transport men, wounded or otherwise, and animals.

The greatest weight on any axle being $7\frac{1}{2}$ tons, a "bridge" rail of about 30 lbs. to the yard, would suffice for the work, carried on beams 12 inches deep by 6 inches wide, the distances between the trestles about 10 feet, and the trestles themselves made of the desired stoutness: the carrying-beams, and centre beam, to be attached to the platform of the trestles by iron knees.

I don't pretend to say that these dimensions are exactly those which would be found in practice to be the best, but they approach sufficiently near to the truth to be able to state that such a line would weigh approximately 200 tons to the mile, and could effect the daily transport of the 3,000 tons of load which are necessary to enable a railway, for the service of an army of 100,000 men, to be constructed at the same rate at which that army could march.

But there is another very important item in the construction of the line, and that is the transport of the various parts of the structure from the terminus of the line to the several points at which the workmen would require to commence simultaneous erection. This would necessitate the employment of a large number of vehicles, a considerable number of horses, and the roadways would frequently be of indifferent order, or of no order at all. I admit it to entail certain difficulties, but if we are employing an army of that size, the crisis will be a serious one, the struggle will be one of severity, and we must not hesitate, in those times, to adopt large measures, whatever may be the immediate cost; nor is it economy to hesitate in peace-time about the cost of carrying out experiments which must conduce to success in war, and which is consequently the soundest of political economies.

I will now conclude, Sir, by drawing the attention of every person in this room most earnestly to the startling fact that whilst Russia, Germany, Italy, Austria, and France all possess organized and well

recognised departments for the military management of railways, *we* are but just beginning to awake from the lethargy which but recently pervaded the mind of the country regarding the conduct of war. It is foolish and unnatural to entertain, with any seriousness, the ideas which do however acquire a certain amount of strength the longer peace lasts, viz., that war is improbable, that war will not come all at once, and so on. I say distinctly and emphatically, that no dependence whatever can be placed on such suppositions, and that if we went to war to-morrow, the almost utter ignorance of railway management, in all ranks of the army, would place it in this, as I fear also in many other respects, in a false position, and not on equal terms with a civilized opponent. It is with these impressions that I have ventured to put my humble shoulder to the national wheel, and to endeavour, in so far as I may be able, to point out what seems to me to be a great want, and a blot on our military escutcheon.

Appendix A.

Table No. 1.

Federal Army, 1863—Construction Corps.

6 *Divisions.*

Each division—Five subdivisions and a train-crew.

Subdivision No. 1.

Supervisor of bridges and carpenters' work	1
Clerk and timekeeper	1
Commissary	1
Quartermaster	1
Surgeon	1
Hospital steward	1
Foremen (one for each 50 men)	6
Sub-foremen (one for each 10 men)	30
Mechanics and labourers	300
Blacksmith and helper	2
Cooks	12
	356

Subdivision No. 2.

Supervisor of track	1
The remainder the same as in No. 1 Subdivision	355
	356

Subdivision No. 3.

Supervisor of water stations	1
Foreman	1
Mechanics and labourers	12
Cook	1
	15

Subdivision No. 4.

Supervisor of masonry	1
Foreman	1
Masons and labourers	10
Cook	1
	13

Subdivision No. 5.

Foreman of ox brigade	1
Ox drivers	18
Cook	1
	20

Train Crew.

Conductors	2
Brakemen	4
Locomotive engineers	2
Firemen	2
Cook	1
	11

Staff.

Division engineer	1
Assistant engineer	1
Rodman	1
Clerk	1
Messengers	2
	6
Total	777

Total of corps nearly 5,000.

Appendix B.

Detail of Plate-layers, Abyssinian Railway.

Divided into 4 parties, as follows:—

1st party.—	2 non-commissioned Officers 8 men (natives)	Laying sleepers at proper intervals, and fish-plating rails.
2nd party.—	1 foreman civilian .... 1 native ganger .... 8 men (augurs) .... 8 men (hammers) ...... 8 men (crowbars)	Spiking rails to sleepers.
3rd party.—	1 foreman (civilian) ...... 1 non-commissioned Officer (platelayer) .... 1 native ganger, with party varying from 20 to 50 men	Levelling, raising, and adjusting the line to enable the ballast trains to pass over it.
4th party.—	1 foreman platelayer ...... 1 non-commissioned Officer platelayer .... 2 gangers with 2 gangs (native) from 40 to 100 men................	Ballasting and finishing the line.

The Chairman: We are all very much indebted to Captain Luard for the able paper he has just read with regard to the application of railways in time of war. We are also indebted to him for having shown the necessity of having an organized railway corps in this country. I know it has been argued that we have a very large supply of railway labour and material always available, but I am perfectly certain that we require an organized military railway corps with our army as much as we require organization in the other branch of the service. We shall be glad to hear any gentleman who may wish to speak on this subject.

Major Powell: By permission of the Chairman, I wish to make a few remarks founded upon personal observation, with reference to the Balaclava railway which has been alluded to in the interesting lecture which we have just heard. In the month of March, 1855, I was appointed to despatch from its upper terminus all the arms, ammunition, and other munitions of war to the army before Sebastopol. I was subsequently, in the month of July, placed upon the staff of the army as Deputy Assistant Quartermaster-General, and entrusted with the chief superintendence and management of the line. I will trespass upon your time a few minutes to point out the difficulties which were apparent in the working of that railway with undisciplined men, and also the great advantages which accrued when it was worked with discipline. On the opening of the line, it was worked by the corps of navvies who had constructed it, but as they were not in a proper state of discipline, grave difficulties occurred. They often times struck work when their services were most urgently needed. The late Mr. Beattie, the civil engineer in charge, exerted himself to the utmost to work the line successfully,—he acted most zealously and patriotically, but unfortunately broke down; he was sent home seriously ill, and died soon after his arrival in this country. On my taking over the line, I considered it best to recommend that these men should be sent home, and their services were replaced by some

men from the Army Works Corps, and by the whole of the N division* of the Land Transport Corps, who were in a proper state of discipline, and worked admirably. Many of them lost their lives in the execution of their duty, and when I required them to work night and day to throw forward supplies for the final struggle, the capture of Sebastopol, several of them to my personal knowledge remained 72 hours continuously at their posts. The traffic on the line, when it was worked with undisciplined men, never exceeded 200 tons per diem, but when it was worked by men in the proper state of discipline, it rapidly increased to 700 tons. I make these references, because I think some preparation ought to be made. From my experience, I came to the conclusion, that in all future wars, railways would render material aid in facilitating the rapid transit of troops and supplies, and the part which they played during the late Franco-Prussian war fully confirmed my opinion. I therefore consider it highly essential on the part of the Government that a small force should be enrolled for the purpose of forming the nucleus of a corps to be at all times ready to construct and work these railways. I do not know that I can say anything more with reference to railways, but I should like to say a word or two about transport as the one question is mixed up with the other. I believe I am justified in saying I have had more experience in the organization and command of transport, than any other officer of the army; and from my experience, I believe that the present system is not in that state in which it ought to be. I am strongly of opinion that the General Officers in command of divisions ought to have the means placed at their disposal to enable them to move all the troops within their respective commands, with their camp equipage, ammunition, and three days' rations of provisions without reference to any other authority whatsoever. The present numbers of the Army Service Corps barely suffice to move 10,000 men; consequently the Control is busy purchasing and selling horses seven or eight months in the year. Such a system may be all very well for the horse-dealers and auctioneers, but I doubt very much whether it is at all well for the efficiency of the army, or for the benefit of the taxpayers. Not many years ago an officer in command of troops could press transport; that power being taken away, in my humble opinion some other power ought to be substituted, so as to keep pace with the requirements of the age.

Mr. Grover, M. Inst. C.E.: I must apologize for addressing you as being a non-military man, but as Captain Luard has been so kind as to bring forward my invention in connection with railways, I should like to say one or two words on a few technical points. When railways were first constructed, they were made almost entirely straight, or as straight as they could be, and a half-mile radius was thought the very outside that was possible. Consequently, when the old stage coach came to be converted into the railway carriage, the pivoting arrangement of the front axle was entirely dispensed with. As we have gone on progressing, we have found that railways have gradually had their curves diminished from half a mile down to ten chains, five chains, three chains, and the more you diminish the curve, the more can you command a country with which you have to deal. That being the case, and being myself engaged in laying out certain railways where I have severe curves to deal with, I thought it was only necessary to endeavour to revert as near as I could to the old stage coach prototype, and in fact to do what an ordinary omnibus does, viz., allow wheels and axles to adjust themselves to the curves; the result has been that wheel-base invention before you which is showing most satisfactory results. I need not say anything about the engine, because that has already been so ably explained to you by Captain Luard, and any words I could say would be superfluous, but I should like to draw attention to one thing. I think it is always right that we should in these matters keep steadily before our minds the leading points; the A B C of the whole question, because it is really that A B C which gets so forgotten by scientific men when they come to deal with these things in practice. If we take two pieces of iron and put them one on the top of the other, we find the upper piece of iron will begin to slide on the lower piece when it is raised at an angle varying from one in four to one in six. That therefore is the limit of the gradient which it is possible for a locomotive engine to ascend. If this iron be exposed to a shower of

* On the reorganization of the Land Transport Corps, the N division was formed into the 8th battalion.

rain, or fog or damp, the upper piece of iron will slide at a much less angle, that is to say, 1 in 10. Therefore about 1 in 10 is the limit of the actual gradient it is possible to work in England. Now if a locomotive engine will just go up a hill of 1 in 10 by itself, it comes to this, that up 1 in 20 it can take a load equal to itself behind it, and up 1 in 30 twice that load, up 1 in 40 three times, consequently if we have an engine weighing 20 tons we can, up 1 in 20, transport 20 tons weight behind it, and up 1 in 30, we can transport 40 tons. Then comes the question what is really the actual gradient that you can get in dealing with a country? That certainly depends to a great extent upon the country. I have surveyed a great many miles of railway myself. Last year I had to report on and examine nearly 400 miles in different parts of Europe, and I may say I have nearly always found that in a country however severe, I could manage to get 1 in 30, provided I could only wind about as much as on an ordinary road. Therefore it all resolves itself into a question of curves, and, having got a system by which I could carry out a very severe system of curves, I can practically command a country by the mere adhesion of the locomotive wheels upon the rails. I would just give you a few practical results as to the cost of constructing very cheap mountain lines. Last year I had to lay out one in the north of Ireland, another in the Austrian Alps, and examine two or three more in the Carpathian Mountains, and in other parts; and I found almost invariably I could make what the Americans call the "roadway,"—(that is to say, that part of the line which is underneath what is technically called the permanent way), on the three feet gauge, for a sum ranging from £1,000 to £2,000 a mile, and that I could get through in nearly every case, with generally under 10,000 yards of earthwork to the mile. That could only be effected by the severity of the curves, and if I had not had the means of using Mr. Fairlie's system and my own invention, I should have been compelled to have had earthworks in many of these cases, amounting to 40,000 and 50,000 yards to the mile. Where you can reduce the amount of earthwork so low as that, it becomes to my mind a great question whether it is not better to use mere earth itself in preference to any scaffolding or staging which can be put up. You had better employ no stages at all, but simply use the old invention of the Barlow rail for temporary military lines. I had better explain what that was. It consisted of a rail with a very wide base of twelve inches, and this was simply laid upon the ground. It has occurred to me, looking at the question in a military point of view as well as I can, that if I were to fight anybody, I should take a quantity of these Barlow rails, and I should get the country surfaced as fast as I could and lay these rapidly through it, because after all as I understand the whole question, war consists in being beforehand; when an enemy has ten men, bring twelve against them, and so by rapidity overcome his forces. I think it is Marshal Saxe who tells us that legs are more important in military matters even than arms; therefore strike your blow rapidly, sharply, and at as many points as ever you can. I will not venture to trespass any longer upon your forbearance, but I think it will be found after all that the question of gradients does very much resolve itself into the question of curves.

Lieutenant-Colonel LEAHY, R.E.: There is so much in what the last speaker has said with which I cordially agree that I desire to say a few words. Following up what he has said, I am strongly of opinion that in the construction of military railways, the possible curves and gradients are the conditions which should technically govern its construction. Given an engine capable of working on sharp curves and steep gradients, it will be found in every way better in a military point of view to construct the railway on the natural ground when possible.

I do not say that circumstances may not arise in which a railway of the construction illustrated by the diagrams and explained by Captain Luard might not be useful. If railways of that construction were largely used in this or any other country for civil purposes, and means were thereby at hand for providing plant of the special construction and character required, I do not say that it might not in certain exceptional cases be expedient to make use of such plant, and construct a railway of that character; but so far as our experience of military railways has yet gone, I do not believe the case has arisen in which it would have been desirable to adopt a railway of such a special construction. It certainly did not arise in the Crimea, and I do not believe it arose in Abyssinia.

Referring to Abyssinia, there is one point to which I desire to call attention. Lieutenant Willans has stated that the general inclination of the ground, along which the railway was made, was 1 in 40. The engineering difficulties of that line arose from having to adapt to that slope a gradient of 1 in 60, so as to take the rolling stock sent out from Bombay to work that line. The engines weighed 16 to 20 tons, and they were not adapted for working up a steeper gradient than 1 in 60. Had an engine capable of working up a gradient of 1 in 40 been available, the engineering of that line would not have been so difficult, and the time required for its construction would not have been so long.

Captain Luard omitted to quote from Lieutenant Willans' account of that railway, the fact that 40 yards of rails were laid per hour, or 400 a day with the light 40 lb. rails, and 250 with the heavy 65 lb. rails. In my small endeavours to carry on plate-laying with soldiers, I have not succeeded in arriving at that rate yet, that is, working from one end of the line to the front. I do not know whether it has been arrived at at Aldershot. Perhaps Captain Luard will say whether it has, but, if it has, I consider it satisfactory. I doubt whether that rate of progress would be exceeded with the trestle construction, because when Mr. Fell states that he can do a mile a day, I think he says he works from several points along the line. He says, "A section having been taken over the ground, and the heights of the rails "above the surface ascertained, the materials would be distributed along the line, "suitable supports having been selected from the assorted lengths sent out from "England." In order to get the special plant selected and laid out along the site of the railway, you would have to provide some means of storage and transport in the first instance, and this is easier said than done.

I do not myself believe we could arrive at so great a rate of progress as Captain Luard assumes.

It may be interesting to know that the War Department is at this moment constructing a line of tramway, four and a half miles long,—which has been entrusted to the School of Military Engineering to carry out,—by partly trained sappers and by entirely untrained infantry soldiers, the working parties varying every day as they would on service. We are using 36-pound rails, and sleepers; the ruling gradient is 1 in 28 for a temporary line, and for the permanent line 1 in 40. The sharpest curve is $1\frac{1}{2}$ chains. The rise in the first mile of line is 130 feet. The small engine we use is simply a traction engine, adapted at a small cost to be run on rails. The tractive power of the engine confirms what Mr. Grover has said. The weight of the engine is about $6\frac{1}{2}$ tons. In dry weather that engine will draw 13 tons up a gradient of 1 in 28, and it will draw eight tons up 1 in 14. Its powers at 1 in 40 I have not yet tested.

I think we cannot but be grateful to Captain Luard and to the Chairman for urging the necessity of the formation of a military railway corps. I can only say that the question of the technical instruction of the engineer troops in railway matters has not been lost sight of in the School of Military Engineering. A small proportion of the limited time allotted for training the junior Officers and recruits, has for some years past been devoted to instruction in plate-laying, bridging for railways, &c., and within the last year the plant for the purpose has been largely increased. Unfortunately, we have, as yet, no authority to devote a lengthened period of time to the training of engineer soldiers in the technical duties connected with the construction of railways, but if about one-sixth of the total number of engineer recruits (which is about 450 a year) were put through a special course of instruction in this branch, we should arrive before long at the nucleus of an efficient railway corps. By training 75 men (*i.e.*, a peace company) per annum, we should very soon, without any expenditure worth speaking of, create an efficient nucleus of a railway corps.

For the subsequent practice of these men, there is an ample field on the State railways in India. The working of these railways would afford employment for for any number of trained soldiers; and if the question was urged on the Indian Government, I have reason to believe the engineer authorities who are charged with the administration of the Indian State railways would be only too glad to see an organized military body largely employed in the working of these railways.

The lecturer has treated the general question under three heads:—1. The

transport of troops on civil railways; 2. The repair, demolition, and restoration of such railways in time of war; 3. The construction of the small military railways I have been speaking about.

1. With regard to the use and management of the civil railways in England for the removal of troops, that of course is a question into which the civil element must very largely enter. The railway authorities and the railway engineers have shown a disposition to act in accord with the military authorities, by forming themselves into an engineer and railway transport volunteer corps, and I apprehend there would be no difficulty in bringing about such an understanding between the War Department and the railway authorities as would, at a small cost, materially enhance the value of our railways for military purposes.

There is a way in which the organization and military value of the railways might be improved that has been already suggested.* It is this. I believe the great grievance amongst the subordinate employés of railway companies is the want of pension on retirement in old age. I have been given to understand, by railway officials, that many men are kept in the railway service for a period of life beyond which they are thoroughly efficient, merely because their immediate superiors did not find it in their hearts to turn them adrift without pensions after having served the companies faithfully for a large number of years. I believe it would be a very great boon to both the employés and officials in charge of lines of railways in England, if we could introduce a system of army reserve with respect to railway employés, that is to say, induce men who have a fitness for that employment, to engage for limited military service, and train them with the Royal Engineers—I say "Royal Engineers," because they are generally men of the class set apart in other countries for engineer soldiers, and such as we enlist. After a short period of service let these men go into the service of railway companies, and let their future liability to military service entitle them to a pension after serving a certain number of years on the railways—say when they arrive at fifty years of age, or some such period. In that way we might have a hold over a large number of railway employés in this country for a long period of years and at a small cost. These men, assisted by the gangers and packers of the railway lines, and under the command of engineer Officers, with whom would be associated the technical officials of the railway companies, would form the basis of an efficient railway or engineer militia.

We have artillery militia and infantry militia, but we have no engineer militia. I would raise the engineer militia from the railway employés, and their locality should be the railways of the country. By some such arrangement we might develope the civil railway organization of this country, which is unparalleled in its efficacy, so as to meet the requirements of the 1st and 2nd heads of the paper read. With regard to the minor question of field railways, I strongly feel, with Mr. Grover, that what we have to do is to adopt steep gradients and sharp curves, and stick to the ground and not attempt any artificial constructions.†

The Barlow rails, referred to by Mr. Grover, were very largely employed in a very interesting operation which took place last year, namely, the conversion of gauge of the Great Western Railway. The advantages of organization were manifested more clearly in that than in anything I can bring tangibly before you. The Great Western Railway from Swindon to Milford had to be converted from broad to narrow gauge, the engineers estimating it would take them six weeks to do the work. They commenced on the 1st of May the first section from Milford to Gloucester, I think about 170 miles in length. They had about 2,000 men employed to carry it out. The actual alteration of gauge was done in about fourteen working days. Then a smaller section was taken in hand, about 36 miles, with a proportionate number of men, but men who had been previously trained and exercised on the larger portion. Exactly the same kind of work had to be done with about

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* See "R.E. Journal" for April and May, 1873.

† A strong objection to these constructions, which was not urged at the meeting, is that they do not afford the same facilities for crossing the line, as railways laid on ordinary sleepers, and thereby are liable to impede military movements across the line of railway.—A. L.

the same proportion of men, and what took fourteen days to do in the first case, was done in less than four days in the second.

Mr. Fell: If you will allow me to make a very few remarks on the observations of Mr. Grover, I shall be glad to do so, for the purpose of showing the use of the centre rail arrangement, which has been referred to by Captain Luard. My experience has differed considerably from that of Mr. Grover. I congratulate Mr. Grover on the easy character of the 400 miles of railway he had to survey last year. The railways I have lately been called upon to examine and prepare designs for, were of a very different character, and required some exceptional method of working and construction. Now it is perfectly possible to adopt the plan under certain circumstances that Mr. Grover alludes to, where the natural formation of the ground is too steep to enable an engine to draw a load over it, and you would make the line, which would otherwise be only 10 miles in length, 30 miles in length. You would, by making the line 30 miles in length, with an ordinary engine, carry the same load that with the centre rail engine you could carry over the 10 miles. Now, for military purposes, I fancy there would be a saving of time, and, for commercial purposes, a saving of money, if you made the 10 miles and not the 30 miles. Not only would there be a saving, supposing the works in both cases are of the same character, of two-thirds of the cost, but you must recollect that these mountain passes, where you require the steep gradients, are generally so narrow that there is no room to develop the line except at an enormous expense. My attention was first called to the necessity of adopting something more than the adhesion given by the weight of the engine in the valley of the Ombrone, where the Austrian and Italian Governments were desiring to make a railway from Pistaja to Bologna, reaching up to the summit at Pracchia. The natural inclination was an average gradient of 1 in 20, but they wished to give to the railway a gradient of 1 in 40. In order to do so, it was necessary to develop the line over very difficult ground, passing through tunnels and over valleys with heavy viaducts, so that while a surface line could have been made over the 10 miles at 20,000*l.* a-mile, the railway was made 40 miles long at a cost of 40,000*l.* a-mile. Consequently that railway cost four times as much, and was twice as long as it need have been, if the centre rail system had been used. Therefore, in such a case, the centre rail principle would have had a very considerable value and advantage over the ordinary system in the saving of time and money. The cost of the Mont Cenis Tunnel Railway was ten times greater than that of the centre rail summit line, and with such an excess of expenditure, it cannot be considered as a commercial undertaking, for it will never pay interest on the capital employed, but it was made for political purposes as a national work by the two Governments. In the case of tunnelling through a mountain there is some compensation for the expenditure, in this way, that there is a great saving in the height to which the traffic has to be elevated, and therefore there is a saving in the working expenses. If you have to gain a certain elevation, say 4,000 feet, in ten miles, you require only the same power as if you took a distance thirty miles to do it; there would be no extra quantity or cost of power required; you double or treble the power for the time being; but then the time employed is less, and the distance being proportionably less, the cost of the tractive power employed is no greater for the centre rail line than for the other. There is therefore a saving in adopting the shorter route; and I think that under these special circumstances, in mountainous districts, the centre rail arrangement will be found to be extremely economical. With regard to Colonel Leahy's remark, that it would be better to stick to the ground, by all means, where practicable, do so; but there are some circumstances when it is absolutely impossible to follow the ground line, for if you do, your engines and trains will stick at the bottom of the hill. At Aldershot, the line Captain Leahy has described, passes over a viaduct 20 feet in height. Supposing you were to adopt Colonel Leahy's plan, you would then have a gradient of 1 in 5 to ascend, but having made your railway over 1 in 5, you could not have got the engine and tender alone up such an incline; you must therefore necessarily have works of some kind. If you could select the ground for war in some place where there would be no works required, and where the ground would not have an unevenness of more than 1 in 30, you would require no other railways than those Colonel Leahy recommends; but if you have ground where works are indispensable, you

must have cuttings and embankments, or their equivalents ; and if you have cuttings and embankments in a railway that requires to be made with expedition, even if those cuttings and embankments are perfectly easy, you cannot make them in less time than you would make an ordinary railway. Therefore, the war might be finished, and the battle lost, so far as it depended on the rapidity of the transport of supplies, before you were able to get your improved means of transport brought into operation. If you require to have works of any kind, the question is what description of works could be most easily executed. I have considered that matter with many practical men, and have not been able to find anything so well adapted as a structure something similar to that which is made at Aldershot. It might be constructed of wood or of iron, the work being executed before the commencement of the railway, and a certain quantity always kept in stock. This kind of structure, as far as our present knowledge goes, can be erected with greater rapidity than any other method employed for constructing railways, and, as Captain Luard observes, time is the most important element in all the operations of war. If Colonel Leahy will make a certain length of line with earthworks, and let me make a similar one with the Aldershot form of structure, and the same number of men, we then shall see which can be completed first.

Colonel Leahy : I am willing to accept that challenge, to survey and execute the railway in the same time, over the same ground ; and with a smaller proportion of "skilled" labour. There is no reason why trestles should not be used with the ordinary gauge as well as with the railway of the special construction adopted at Aldershot, but if possible, their use should be avoided by employing a larger number of unskilled workmen on earthworks.

Mr. Grover : Mr. Fell objected to this gradient, because it was 1 in 20, and stated, I think, that the Austrian Government were not able to get their engines up. I would merely mention that on the Taff Vale Railway, there are engines working every day over a gradient of 1 in 18½, and that on a Mexican line they are now working up a gradient of 1 in 25, 13 miles on end with the Fairlie engine.

Captain Luard : I have very little to say in reply, because the objections taken have been answered by the various gentlemen who have been speaking. Colonel Leahy stated that in his opinion the length of railway made in Abyssinia per diem was as great a length as could reasonably be anticipated to be made in any one day. (Colonel Leahy : Working from one point.) The number of men employed in making 400 yards of line per diem with light rails, or 250 yards with heavy rails, was 268, but there is no reason why the number of men should be limited to 268. You may employ a far greater number of men even starting from one point. I cannot admit at all that 400 yards is the limit that you can make in one day, nor can I see any reason why you should limit yourself to working from one point of the line. At Metz the Germans had 300 waggons available for their railway work, and they started from various points, and practically one would always make every endeavour in constructing a railway, to start from as many points as possible. Therefore I do not see that there is any necessity for fixing 400 yards as the limit to be done in a day. If you can transport the materials for a line of railway to a certain number of points, I assert that you can construct ten miles of railway in the course of a day. Colonel Leahy has not attempted to disprove that with a sufficient amount of transport, ten miles of railway could not be constructed in the course of a day. I have shown that a railway could be made to transport without any difficulty the total weight of structure for one day's line, that is to say ten miles, and if transport could be provided at the terminus of that line to distribute the materials for the next day's work, it could be done. I do not quite understand what object there would be in establishing the nucleus of a railway corps in India; though it would be of some advantage to India, it would not be of much advantage to Great Britain. We never know when the moment may arrive when we shall want the railway corps, and I do not think India is the place to establish it. With regard to the gradients more especially in India and Central Asia, I think you would find many cases would occur in which at least a gradient of 1 in 20 would have to be encountered. In a country so irregular as Central Asia, where it is possible we may have some day to construct railways, I do not think you could depend upon it that 1 in 30 would be the ruling gradient that you would have to work over.

Lieutenant-Colonel STRANGE, F.R.S.: I should like to ask the lecturer if he would give us his opinion as to the relative cost of maintenance. We have not considered the subject of maintaining these lines. I think myself it is a very important part of the matter, and I think Mr. Fell's system presents certain facilities with regard to it.

Captain LUARD: The cost of maintenance is not a question I have anticipated at all. It is not expected that a field railway will be required to last beyond a limited period, and if it is made sufficiently well in the first instance, I anticipate it will last out the time required for the purposes of a campaign.

The CHAIRMAN: I will not protract the discussion, but I have much pleasure in conveying your thanks to Captain Luard for his valuable paper.

Evening Meeting.

Monday, June 16th, 1873.

The SECRETARY of the INSTITUTION in the Chair.

NAMES of MEMBERS who joined the Institution between the 10th and 16th June, 1873.

LIFE.

Pemberton, S. E., Capt. R.A.

ANNUAL.

Duncan, A. W., Capt. R.A.
Arkwright, F. W., Lieut. Coldstream Guards.
Mackean, Kenneth, Lieut. R.E.
Fitzroy, A. W. M., Lieut. Coldstream Guards.

ON IMPROVED LIFE-BUOYS, AND A SYSTEM OF DECK-RAFTS FOR SAVING LIFE AT SEA.

By Mark Hamilton, B.A., M.D., Surgeon R.N.

I desire to occupy your attention for a brief space this evening with some appliances for saving life at sea. I trust my subject will not seem tame in comparison with those to which we have been so much accustomed in this room. Perhaps I should have a better chance of commanding your interests if I were bringing forward some tremendous implement of destruction, or even if I could offer food for your intellectual capacities, and delight you with some of those beautiful and complex mechanical inventions or ingenious scientific discoveries such as we have heard here from a Bessemer or a Froude. Still, I am encouraged by remembering that such a subject as this is sure to commend itself at any time to an assembly of Englishmen, whose characteristic it is, that "nothing human is alien to them;" at this time especially, after a winter of unexampled severity—unparalleled for the suddenness and extent of the disasters at sea on our own shores—our hearts deeply stirred at the time, and when every one is asking, "can nothing be done to mitigate, if not to prevent these terrible disasters;" and although much has been done, I think I can show you that much still can be accomplished in the same benevolent direction. Terrible as is the picture of human life lost at home, shown every year in the Wreck Chart, I believe we have no idea of the number of poor fellows who are lost at sea, of whom no one takes account, of whom the only record is a word or two in the log "lost overboard!" When men in the merchant service fall overboard, which they often do from the defective condition of the gear aloft, old and worn out, and kept too long in use through

motives of economy, I believe the chance of their ever being heard of again is extremely small. The difficulty of getting their boats out in a seaway, short-handed as they usually are, and the short time, if any, in which the unfortunate man remains in sight, generally decide the captain to leave him to his fate, without an effort to save him. Then the sort of thing which is supplied to them in the shape of life-buoys is generally most inefficient, altogether incapable of sustaining them in the water any length of time, even if they succeed in seeing and reaching it, and in warm climates, escape the attacks of sharks. Some experiments were carried out two or three years since by Mr. James Greenwood,—then well known as the "Amateur Casual," from his personal investigations into the state of our casual wards—on these life-buoys, purchased at random from the slop-sellers at the east end of London. They are supposed to be made of cork, but were found to be composed of any other material, shavings, rushes, oakum, straw, or any thing to fill up the space, their floating power was therefore soon exhausted. Of three specimens on which he experimented, and which cost from 4 to 6 shillings each, No. 1 was marked "warranted corkwood." On a weight of 10 pounds being attached, it sank in an hour, proving it to be composed of straw. No. 2, marked simply "warranted," swam for 2 hours; it was stuffed with rushes. No. 3, marked "all cork," floated for 4 hours; it consisted of cork chips outside, about 20 per cent. of the bulk, the rest, rushes and shavings. These ring-buoys are also supplied by contract to Her Majesty's ships, but whether any steps have ever been taken to test their efficiency I know not. A question was lately asked in the enquiry into the loss of the "Northfleet," how it happened that no one was found clinging to any of the life-buoys known to have been on board. Perhaps these investigations may serve to supply an answer.

I would now speak of the life-buoy so well known to every one in Her Majesty's service. It is the invention of Lieutenant Cook, so long back as 1811; since which time I may say, little or nothing has been done to improve it. I do not think there is any one, who has had any experience of it, who will not be found to condemn it. Indeed I have often heard it asserted, that more lives have been lost through it, than saved. It is rather a painful reflection to think that so much has been done by human ingenuity in the means of destroying human life, and so little in saving it. In the Committee which assembled at the Admiralty last year to investigate the subject of lowering gear and life boats, the enquiry—thanks to the energy of Mr. Bouverie—was extended to life-buoys. The testimony of nearly every witness agreed in condemning the service buoy as useless and dangerous; some going so far as to say it was more calculated to drown men than to save them. The lightest judgment passed on it was, that it needed much improvement. I am pretty sure the experience of every naval Officer who hears me, is in accordance with that testimony; and I may mention here in passing, that the only life-buoy that received any commendation, was the one I now show you. Several witnesses who had seen it tried, some who had had it fitted to the ships which they commanded, spoke highly of its practical merits; yet the Com-

mittee had not a model of it even before them, and an application from the inventors to attend and explain its principle, was not entertained.

Well, Sir, that Committee issued their Report, and gave us their ideas of what an efficient life-buoy ought to be, but I regret to say they did not ascertain for themselves whether there was not in existence a buoy fulfilling more than their own requirements. The Committee laid down, that an efficient life-buoy should be capable of sustaining a man in the water without effort on his part; secondly, that the light on a buoy for use at night, should be so placed, as that the sparks or flame should not fall on the man swimming to it, and thirdly, that the light ought to burn at least twenty minutes. These, in their opinion, are the conditions of a good life-buoy. It is easy, I think, to show that many qualities just as necessary have been omitted. One property, valuable above all others is, that of discernibility: the life-buoy should be visible as long, and as far off as possible; it should be easy of access; it should afford protection from attacks of sharks; and if possible, have a supply of fresh water, the most valuable aid in recovering a man stunned by the shock of sudden immersion, and the struggle for life he perhaps had, before reaching the life-buoy. Now, I ask how many of these properties does the life-buoy, so long, and now almost universally supplied to Her Majesty's ships, possess? I think I can confidently say not one, yet these are the implements which the Committee pronounce "the best generally known." With regard to the property of discernibility in a life-buoy, I would for a moment recall to your recollection the sad accident last year to the boats of the "Ariadne;" an event which caused such a painful emotion in this country. It will serve to illustrate the vital importance of making a life-buoy as discernible as possible. When the unfortunate man first fell overboard, the buoy was of course instantly sent after him, so that even if he never reached it, it could not have been far from the place where he fell; yet the crew of the boat sent to pick him up, declared, that they had never seen either the man or the life-buoy, proving that they never could have been near the place where he fell, and of course had no chance of saving him, as they did not know whither to pull to seek him; whilst perhaps the unhappy man might have been clinging to the buoy, and watching with straining eyes the boat pulling in every direction but the right one, until it capsized, that is, if his strength enabled him to hold on. Now, had there been an efficient life-buoy in this instance, capable of being seen at a distance and efficient in other respects, the boat would have known whither to pull, the man most probably would have been saved, and when the boat capsized, there would have been an implement at hand capable of sustaining at least as many men as perished. It was this accident to the boats of the "Ariadne" which led to the appointment of the Committee. In the course of their enquiries into this branch of their subject, many excellent suggestions were thrown out, such as the immense advantage of having a life-buoy, which being known to be efficient, and capable of sustaining the men until help arrived, and even longer, would relieve the mind of the Commanding Officer from pressing anxiety as to the man's immediate

safety; he could then so much more leisurely and calmly see to the deliberate and careful lowering of the boat without risking the lives of the crew by undue hurry, as is now often the case. But after all, let me ask to what practical result have the labours of the Committee tended? So far as I can see, I am at a loss to discover. Have we had, or are we likely to have any practical test or trial or means of discovering which of all these appliances is the best for the public service? A short time before the present Board of Admiralty came into office, a series of experiments were ordered to be instituted at Sheerness and Portsmouth on the life-buoys then known. They were thoroughly carried out by Admirals Sir Jas. Hope and the present Sir Astley Cooper Key, in the presence of a large number of Officers; but from that day to this, nothing has been done to act upon those experiments and reports; and though this buoy, which I show you, was highly commended, no steps have even been taken to supply it, or, if possible, a better one, to the service generally.

A few have been fitted to the Indian troop-ships; and at the last moment, on the urgent request of Captain Nares, one was supplied to the "Challenger." A distinguished Officer lately called from the Council Board of this Institution to a position of high command, one whose absence from amongst us for a time we shall all regret, about to take his ship to the antipodes, applied, I understand, several weeks since, to have her fitted with one of these life-buoys, but only at the last moment,—and I believe too late to have it made and fitted,—was the order given. Some of you will remember a similar story told by Mr. Lacon in this room of Hill's lowering gear being ordered for the "Challenger" when on the point of sailing; and there being no time to fit it properly—she lost a boat in a gale in the Channel.

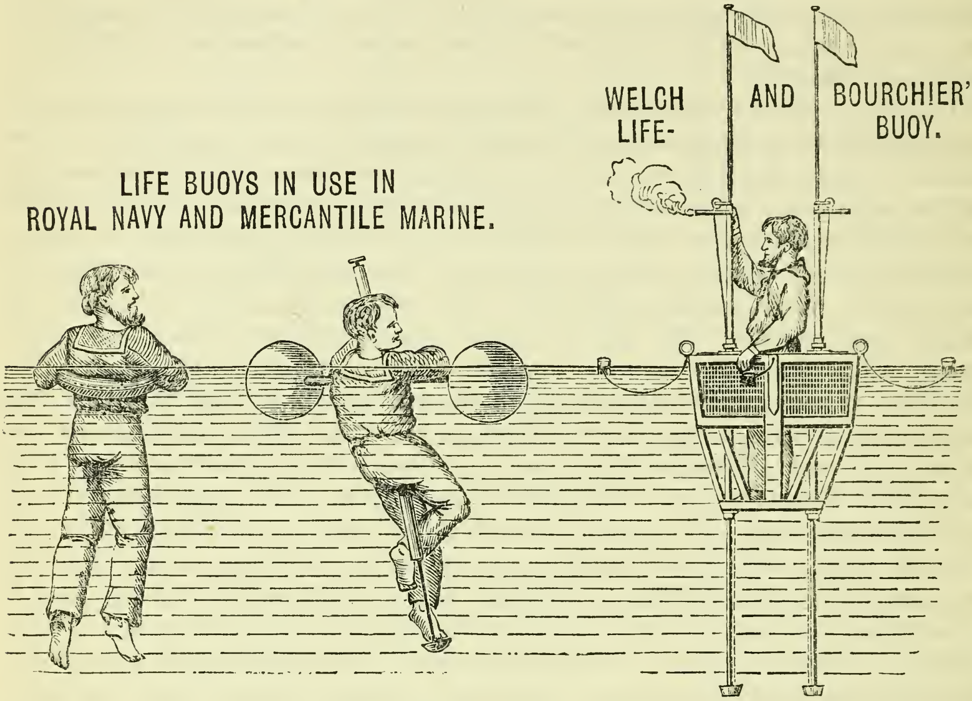
At an exhibition lately held at the London Tavern in connection with the "Northfleet" fund, an immense number of appliances were exhibited for saving life at sea, and amongst them, a vast amount of ingenuity was displayed, and no small interest was manifested by the public at the time; but I regret to think that no practical result has followed or seems likely to follow. As one of the Council of the Institution, who was chosen to pass judgment on them, sensibly remarked, "Nothing can be really known of their practical merits until they are "practically tested," and that I fear is a consummation exceedingly remote. Here is again another instance of wasted energy. As a nation we seem to be sadly unpractical—our feelings effervesce; the occasion passes away, and leaves behind nothing but a residuum, "flat, stale, "and unprofitable." Would not the proper thing, after such an exhibition as that, be, to have a practical trial by, say the Board of Trade on behalf of the mercantile marine, and by the Admiralty on the part of the public service, and find out what are the best practical appliances, and having found them out, adopt them into the Royal Navy, and insist on their being adopted into the merchant service? I know as a fact that more than one kind of life-buoy has been brought to the notice of the present Board of Admiralty, but with what result? The last time I was at Spithead I saw hanging at the quarter of the "Bellerophon" a modification of the old service

buoy, with certain improvements, no doubt, some of them copied from this buoy. It is, I believe, the invention of a carpenter in the service, and in the "Liverpool" took a voyage round the world in the Flying Squadron, but what is its practical value? Has it been tried or reported on, or is it going to be adopted? Has it been tested in competition with any others?

I am not here to sound the praises or unduly to exalt the merits of any particular invention—but I would impress most earnestly on the minds of you, gentlemen, who are members of this Institution—some of you who are, and some who may be at any moment called to the administration of our naval affairs, or to hoist your flags in command of our fleets, or be appointed to commission our ships—to look to this serious defect in the equipment of the ships in which we serve. Do try and use your influence to have that antiquated, obsolete, useless, nay dangerous, implement misnamed a life-buoy—ought to be called a death-buoy—utterly abolished out of the service, and something really calculated to save life, adopted in its room. It is no defence of it to say, as one or two witnesses have said here, that they have seen men saved by it; the same might be said of an oar, a hencoop, or a spar; but will they trust to such things in the hour of peril, or are we justified in providing nothing better for the rescuing of men and Officers who suddenly find themselves overboard? I am afraid we owe to the comparative rarity of the accident of men falling overboard—due to the nerve and skill, agility and discipline which distinguish our seamen—that for so many years nothing has been done to improve the service buoy. But happily we live in times remarkable for a vastly increased appreciation of the value of human life, and for a chivalrous heroism ever impelling men to dare the rescue of others' lives at the hazard of their own. Do we ever hear in these days of a man falling overboard without also hearing that one, two, or three men or Officers have sprung instantly to rescue him, hardly waiting to divest themselves of the clothes that add so much to their danger? Surely it is incumbent on us to aid by all means in our power such gallantry and devotion. Let us reflect, moreover, a little on what is likely to happen in future wars carried on at sea. How is human life most likely to be destroyed? I venture to say not chiefly by shot or shell, not by cutlass or pistol, but by drowning. Our guns are few, if tremendous; the action will be ended one way or the other before many shots have been fired, or suddenly, by ramming, or torpedo. Are we not bound, then, to devote our attention and ingenuity to devise the best means of saving life from drowning? I should feel very proud if I thought that our meeting here to-night would do something to promote that end before we find ourselves engaged in a war in which everything will be as new to us as if we had never been at war before, in which we shall have everything to learn, and in which it will be well for us, if the indomitable pluck and nautical skill of our seamen be not overborne by the irresistible might of scientific invention.

The life-buoy, of which this is a model, consists of an air-tight, oval, thin metal casing, about 16 inches deep and 6 inches across, forming a double cylinder, and having a central space of 18 inches by

16, open from top to bottom for the reception of the person or valuables to be saved. The interior of this casing is divided into two



parts by a partition of metal, which is about 14 inches from the top, giving a capacity of about $3\frac{1}{2}$ cubic feet, and leaves a space of 2 inches, which is to be kept as a reservoir for fresh water to be used by the person saved in the event of his being compelled to remain adrift from his ship by reason of bad weather, fog, &c. This water space has two tubes leading to the top of the buoy, which are fitted with india-rubber nozzles or mouth-pieces.

The air-tight casing or floating power is sheathed or covered with wood battens, tongued together to afford protection against the stem of a boat or boat-hook used in picking up the buoy, also to prevent the metal being bulged, if it strikes the side of the ship in hoisting. This casing, which may be made in one or more compartments, and of any suitable metal, is enclosed in an open framework of iron or steel, connected by rivets, having a grating or small platform at the bottom, on which the man stands; this grating is about 3 feet from the top of the buoy, thereby leaving a man's vital organs (to use a popular term) out of the water. This apparatus is further provided with two stationary hollow tubes or sockets, about $1\frac{3}{4}$ inches in diameter, passing from top to bottom, each containing a signal staff for the purpose of indicating the position of the buoy to the man in the water, to the boat sent to rescue him, or to attract the notice of a passing vessel. Each signal staff is telescopic, being formed in two or more parts or sections, fitting the one in the other, the whole being contained in the stationary sockets before mentioned. The signal staff is automatically

raised out of its socket, on the buoy being "let go" by means of a weighted rod sliding in the stationary socket. To the telescopic mast or staff are also attached port fires or fuzes, to serve as signal lights, one being ignited by the action of "letting go," while the other is at the service of the man in the buoy to show his position at night. The first or port fire section of the signal staff is raised out of the socket by means of chain or copper wire rope, one end of which is secured to the lower end of the weighted or ballast rods, and passing over a sheave fitted to upper part of stationary tube is attached to lower part of port fire section, working in a slot or groove cut in the stationary tube. The upper or flag section of the signal staff is raised in a similar manner. one end of the cord being secured to the upper end of stationary tube, and passing over a sheave fitted in upper part of first or port-fire section is attached to lower end of flag section. The flag attached to this section or table is nearly 7 feet from the water. The upper part of the buoy floats 6 inches, and when a man is in it, about 2½ out of the water; the outside ledge of the buoy, made of an oval shape, is about 32 inches by 30, and 34 inches deep, tapering from 16 inches, the depth of casing; the interior 18 by 16, masts above water 5 feet; weight of whole about 130 lbs.; the platform or grating is about 16 by 15 inches. The arrangement for suspending and letting go this apparatus, which may be hoisted by any suitable tackle, one extremely simple, consists of two hollow tubes as davits, projecting horizontally from the ship's stern or quarter, or under the bridge end. A sliding bolt in each davit taken into an eye or loop on the sides of the buoy next the telescopic masts being received into a slot on the under side of the davits, which is thus securely attached. A cap is fitted to rods between the davits above each signal staff, to prevent the latter rising into position, when the buoy is suspended at the davit. The buoy is detached by withdrawing the bolts before mentioned, which are connected on board by a bar, having a hook in the centre, over which the trigger line for firing the fuze is looped, thus the action of firing and "letting go" simultaneous. If the port fire is not to be ignited, the trigger line is detached from the hook previous to letting go the buoy, the line remaining pendant from the port fire-pan, so that the means of igniting the same always remains at the command of the person in the buoy. There has been lately brought to our notice in this Institution the self-igniting signal of Mr. Holmes, which seems an invention admirably suited for life-buoys at night. It is inextinguishable, burning on the surface any length of time, thus fulfilling two of the requirements of the Committee, viz., avoiding sparks and fire on the man's face, and burning a sufficient time. It made a brilliant show on the Serpentine, in the exhibition of "night-signals" of the "Northfleet" Committee. It seems the best thing yet discovered for the purpose, and it is proposed to adapt it to this buoy. Corks or other floats are attached to the upper rim of the iron framework of the buoy, with bights of rope to catch at, so as to sustain a number of men hanging on. In pointing out the advantages of this buoy, it may be noticed, that it is capable of sustaining a boat's crew, by holding on to the floats and bights, that it carries fresh water enough to sustain life for days should the man be lost sight of, or the

weather be too bad to pick him up, that in the event of a man in the buoy losing his ship altogether, it affords great additional chance of saving his life, from the facts of his having water to drink, signal-fire at night, and signal-flags by day, nearly 7 feet high, always flying so as to attract passing ships; it affords complete protection from sharks; it can be hoisted up with a man in it, without having to lower a boat or send men outside the ship; and that in the case of the total loss of the ship, all ship's papers, chronometers, and other valuables might be stowed in it, certain of being eventually picked up by some passing ship.

The life-rafts (of which I regret I am unable to bring before you a model this evening), though perhaps not always applicable to men-of-war, ought to be of vital importance to merchant and passenger ships; in fact, it ought to be enacted by the Board of Trade that no such ship should sail without some such appliance. It is proposed to fit the skylights, deck-seats, bridges, or roofs of deck-houses with air-tight compartments, somewhat similar in construction to the life-buoy; and by a simple arrangement of chains and spring hooks, to connect them together, and thus make one large and safe raft. Each compartment of this raft may have a supply of fresh water always available, and if fitted with telescopic masts, will have signal fires to use at night, and signal-flags by day. It will be observed that no preparation is required to connect these seats and skylights into a raft, the masts and water-tanks being similar to those used in the life-buoys. To show how much space may be utilised without taking up more room than the ordinary seats and skylights, suppose the upper deck to be fitted with one skylight and four deck seats, the skylight is, say, 12 feet long and 6 feet wide, having an aperture 9 feet long and 3 feet wide, thus having the seats of skylight 18 inches high and 18 broad, then the four deck seats being 12 feet long, 18 inches wide, 18 high, will give altogether 175 cubic feet of enclosed air space and 144 square feet of standing or sitting room, more than sufficient for 50 persons. The lower part of aperture of skylight should be fitted with two broad flaps of large-meshed netting, so as not to exclude air or light when used as a skylight, and serve as a floor for standing on when floating in the water. These rafts always serving as necessary articles, might be made to take the place of those numerous and expensive lifeboats which merchant ships are now compelled to carry, but which are so seldom found available when wanting. Thanking you for the kind indulgence with which you have listened to me, I shall only add, " Si rectius isto novisti, can- " didus imperte, si non, hoc utere mecum."

Mr. Holmes, electric engineer: As proprietor of the light that Dr. Hamilton has spoken of in connection with the life-buoy, I may be allowed to point out that one of the great values of the signal attached to a life-buoy is, that it shall be self-igniting and also inextinguishable. I do not think Dr. Hamilton quite explained that this signal when the buoy falls into the water, lights itself. If an ordinary life-buoy is thrown over on a dark night it is almost impossible for a drowning man to find it, and also it is impossible for the vessel to find the buoy and the man, even supposing he succeeds in reaching it. By having a signal which ignites in the act of falling into the water, you overcome one of the chief obstacles to the saving of life. I do not wish to enlarge on the merits of my new light, but at present it certainly does fulfil three very im-

portant conditions: it is inextinguishable in the water; it ignites on contact with the water; and it will continue burning fully one hour.

Captain Calver, R.N.: Dr. Hamilton remarked on the possibility of hoisting this buoy up with a man in it, but I did not exactly understand from his description how the buoy is to get to the ship. I do not suppose the man in the buoy has the means of propelling it towards the ship; in fact, the ship, under sail, will have to pick up the buoy, which every seaman knows is a very awkward and nearly impossible thing to do. I have been 44 years in the naval service, continuously engaged, and have often seen the old life-buoy let go, and so far as my memory serves me, I never knew a man's life saved by it. There is one thing in the Doctor's life-buoy which is extremely meritorious, that is its visibility. Now, as a practical surveyor I have been usually in the habit of using floating objects, and I have had no difficulty whatever at a distance of five miles in reflecting a floating object in the water. If that be so, it is quite clear if the Doctor has any means of attaching tube flags to that buoy it will really be a most valuable addition. I cannot conceive anything more important than that. Without knowing of the failure of the upper mast, I should have ventured to predicate that. It would be difficult indeed for a buoy to go fairly into the water free of everything without damage to your upper or top mast. Therefore I should sooner see some flag attached to your lower section, which would be ready to be unfurled by the man when he gets to it. Then another great merit as compared with the old buoys is, that when once the man is in it, there is no need of any further personal exertion; that is a very important thing. The whole thing strikes me as being a most valuable improvement upon the buoy which I have been used to see during service at sea.

Dr. Hamilton: You spoke of the man in the buoy getting into the ship. Supposing he is towed by the boat sent to pick him up, of course it is a great advantage that the man should be able to be hoisted up just as he is.

Captain Calver: I understood you to say the buoy might be hoisted up without the necessity of lowering a boat; that is the point that struck me.

Dr. Hamilton: The weather might be very bad, too bad to lower a boat; at the same time the ship might work up to where the man was in the buoy, and you must remember that in this buoy a man will be sustained for hours. That is a very important point to anyone who has had the experience of seeing a man trying to cling on to the old man-of-war's buoy when there is no sea on, for it is impossible to do it when there is a sea on. It is impossible that he can hold on to the buoy for any length of time, even in smooth water. But here is a buoy which will sustain a man for a very long time, and in the case of a merchant vessel which is short handed and cannot lower boats, the man might be in the buoy long enough for the ship to work up to him and pick him up without lowering the boat at all. With regard to the masts, of course the masts are an invaluable property of the buoy. The discernibility of this buoy and the utter impossibility of seeing the service buoy at any distance from the ship, are in strong contrast. The masts are most valuable. I quite approve of the idea of Captain Parkyn, H.M.S. "Crocodile," of adopting two light ash rods to carry small flags. Then as to the accessibility of the buoy, the man swims to it, he takes hold of the bights or the floats, and he gradually draws it to him, he cants it over and gets in, and, as I myself have seen in the experiments at Portsmouth and Sheerness, the ease with which the man gets in, is something wonderful.

Captain Bourchier, R.N.: I may say I have seen it myself with one man inside and eight men holding on with their chests above the water. As to getting into the buoy, to use the words of one man, it was just as easy as stepping into a carriage.

The Chairman: I am sure you will allow me to return your thanks to Dr. Hamilton for the excellent paper he has given us.

GRIFFITHS' PATENT BOW- AND STERN-SCREW STEAM-SHIP.

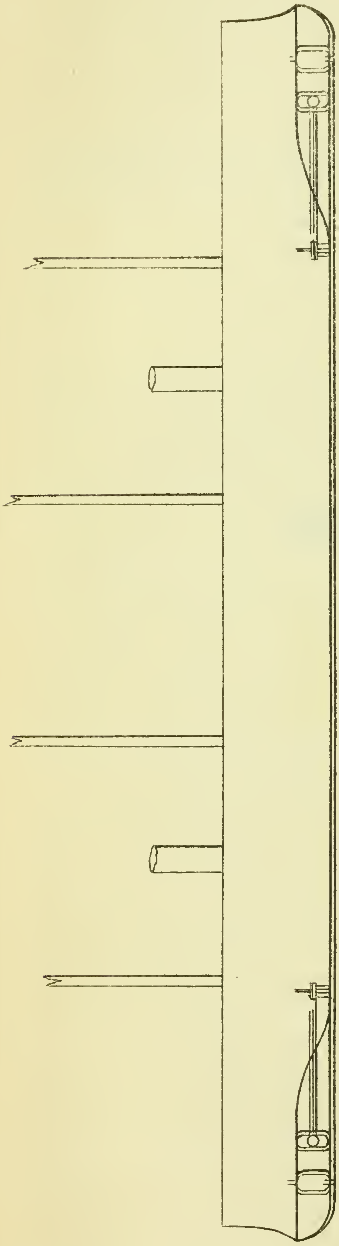
By R. Griffiths, Esq.*

Having taken great interest in the propulsion of screw steam-ships for several years, and being fully alive to the vast importance of steam navigation both for war- and also for mercantile-ships,—to the improvement of which propulsion I have devoted a great deal of my life,—I trust that I shall be pardoned for occupying your time by calling your attention to a few practical suggestions that I wish to make, and also for bringing before you the results of a series of experiments which have occupied me for nearly two years, first upon working models, and latterly upon a small screw-steamer, the "Alpha," by means of which trials I have arrived at conclusions which will, in my opinion, form the basis of a new and improved system or arrangement for working screw steam-ships.

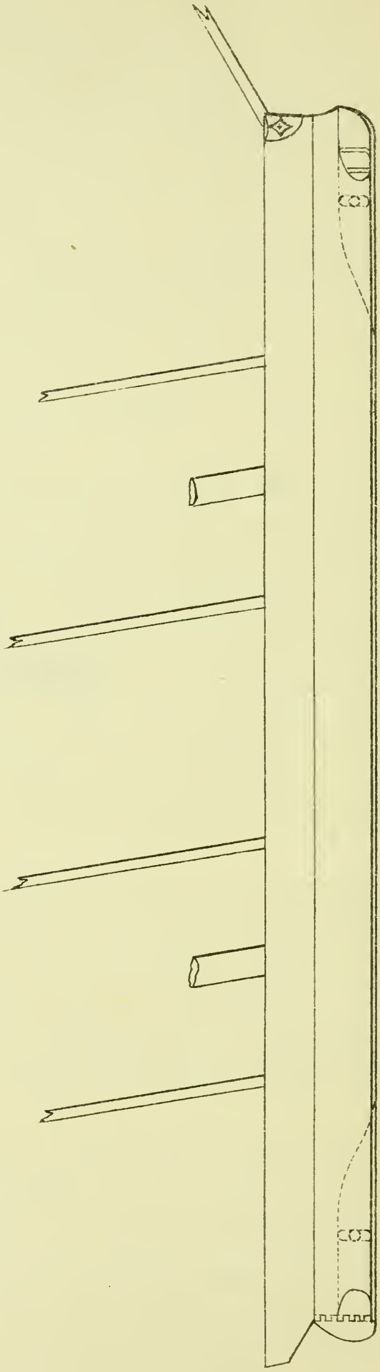
Since the introduction of my improvements in screw-propellers in the year 1849, there have been numbers of patents for improvements in screw-propellers; but the only one of these so-called improvements that has stood the test of time and practical working, has been that of the enlargement of the boss, and the making the blades narrow at the points and wide at the roots, in contradistinction to the plan generally used prior to that date, which plan was the reverse of that I both then, and since, have advocated.

I have tried several alterations in the form of the screw without, however, obtaining any material improvement in the results, and my experience has led me to believe that no real good is to be looked for in the mere alteration of the form of the screw itself, that subject being exhausted; and that if any further advance is to be made in screw propulsion, it must be sought in the manner and position in which the screw is to be applied to the ship, or, in other words, the manner of applying the propeller to the object to be propelled; it being borne in mind that experience has shown that the greater the length of a steam-ship in proportion to her beam, the greater also are her economic advantages.

* Read at the Evening Meeting on Monday, June 16th, 1873.



BOW AND STERN SCREW RAM OF THE FUTURE.



OCEAN STEAMSHIP OF THE FUTURE.

J. Jobbins

Our own reason tells us, and the assertions of tried sailors confirm us in the opinion, that a vessel of 400 to 500 feet in length and 45 to 50 feet beam would be, should her engines break down in a heavy sea, a perfectly unmanageable mass, unless indeed such a vessel happened to have the advantage of a breeze, which, by means of her canvas, would give her a speed of about four knots an hour, or at any rate sufficient to obtain steerage way and cause her screw to revolve, and the probability is that, unless her canvas would give her that speed, she would get into the trough of a sea and would share the terrible fate of many large and first-class ships which have not been seen or heard of after leaving their port of departure.

In order to avoid some of the difficulties and dangers that now attend screw ships and also to improve their speed, it occurred to me that if, in addition to the screw at the stern, another propeller were applied in the bow of the ship,—both screws being placed in tunnels formed in the sides of the ship so as to be protected from coming in contact with such objects as a ship's anchor or cable,—it would be the means of avoiding a great many of the difficulties and dangers now attendant upon such ships.

In order to test the truth of my supposition, I had models prepared with strong clock-work springs to work the screws, in a manner similar to that which I employed when experimenting upon my first improvement in the screw-propeller.

Model No. 1 delivered the water on each side of the bow, and this bow-screw alone gave a result which, so far as speed is concerned, was as good as that obtained from the stern-screw worked in the ordinary way; and when reversed to drive the model astern, it showed a decided superiority over the stern-screw worked in the ordinary way.

I afterwards had made Model No. 2, which delivered the water from the bow-screw underneath the ship, and took in the water for the stern-screw from underneath, so that both ends of the ship were made the same below the water line; this I found to be the best arrangement, as the bow-screw itself gave a better result, in consequence of the water discharged from the screw meeting with a greater resistance, giving the same effect as is now produced by lowering the screw, and thereby obtaining a deeper immersion of the blades.

Another great advantage may be obtained by this method of placing the screw, and that is, that the screw may be made to discharge any bilge water or any great leakage that may happen to take place in the vessel.

This may be effected by having a discharge from the bilge to the forward edge of the screw in the stern-tunnel, when, by opening a sluice-cock or valve, the screw will draw its supply, or a portion of it, from the bilge, or the inside of the ship, instead of from the open stern, as shown in the drawings.

Model No. 3 is of the steam-ship "Alpha," as she was first constructed, but she was afterwards cut in two, and 8 feet added to her length, making her 50 feet long and 9 feet beam. On one side, are the tunnels as fitted, and the other side shows what she ought to be if my system

had been correctly carried out, which would no doubt have given a much better result than was actually given by the trials. This I have proved by my former experiments with models properly constructed.

Model No. 1 I first had made, with its discharge openings on the side of the ship, and No. 2 with the discharge openings underneath the ship.

A series of experiments with these models were conducted by Mr. Bevis, the manager of Messrs. Laird Brothers, in a trough 50 feet long, the boat being worked by the springs that are now in the model, and wound up the same number of turns for each run, the time being taken and the winding done by Mr. Bevis, which experiments gave the following results, taking an average of three runs :—

First three runs, with the screw at the bow in the open water, the time was 90 seconds and 511 revolutions of screw.

Second three runs, with the screw in the bow-tunnel, 71 seconds and 450 revolutions.

Third three runs, screw at the stern in the open water, on the old system, 80 seconds and 493 revolutions.

Fourth three runs, screw at the stern in the tunnel, 66 seconds and 430 revolutions. With one engine at the stern-screw and one engine at the bow-screw in the tunnels, it was 46 seconds and 416 revolutions.

The result of some trials made on the steam-ship "Alpha," at Lynn, on the 14th and 15th May last, showed that 160 revolutions per minute of the stern screw alone gave a mean speed in eight runs of 4·921, screw working in the tunnel.

160 revolutions per minute of the same screw gave a mean speed in eight runs of 4·626, screw working in the open water in the ordinary way.

160 revolutions of both bow- and stern-screw together, gave a mean speed in four runs of 5·820.

By cubing the speed of the runs with the screw working in the tunnel and in the open water, it gives 20 per cent. less power required by the screw when working in the tunnel to obtain the same speed as when working in the ordinary way.

The steamer "Alpha" is now at Lynn, and any persons that may desire to witness some trials made with her can do so by giving one or two days' notice to that effect; but such trials must be completed this week, as the owner is on the point of removing his vessel.

From the above facts, and trials that I have since made with the "Alpha," I can confidently assert that the advantages enumerated below will be found to exist over the present system of steam-ship propulsion.

1st. A considerable gain in speed or with reduced engine-power, the same speed is obtained as by the stern-screw alone, but with a considerable saving of fuel; a matter of vital importance at the present time.

2nd. Complete protection to the screws and rudders is insured by the tunnels, thereby avoiding the breakages of the exposed screws and rudders now frequently occurring in screw-ships.

3rd. In order to obtain the same propelling power as with the single screw, the bow- and stern-screws only require to be one-half the diameter of the single screw, and being fixed as low down as possible, the engines and screw shafts are more safely placed in the ship; the bow and stern-screw propellers being of smaller dimensions than in the single screw ship, smaller engines will be required, thereby effecting a great saving of weight and expense.

4th. There is no vibration from the action of the screw-propellers when working in the circular tunnels.

5th. A ship with bow- and stern-propellers can be stopped when going at full speed in less than one-half the time and distance that a ship can be with a stern-screw only. When the bow-screw is reversed the bow-rudder will act on the ship immediately, whereas in stopping and reversing the engines of ships with *stern-screws only*, the momentum will carry them in a straight line a considerable distance, owing to the stern-rudder not acting when the screw is stopped or reversed. The effect of this must be at once apparent, as in one case, not only is the speed reduced in less time, but the ship can be rapidly turned from her course, owing to the immediate action of the bow-rudder, while in the other case the ship proceeds in a straight line until the speed is checked by the action of the reversed screw or the exhaustion of her momentum.

6th. It will do away with the racing of the engines when in a heavy sea. With single-screw ships when the screw comes partially or wholly out of the water the engines get released from their work, so that without great care on the part of the engineers in checking the steam they are liable to become disabled; besides this, the ship loses its momentum, whereas by the proposed system the stern-screw cannot lose its water unless the stern and part of the keel are lifted out of the water, as the supply of water to the screw is taken from *underneath* the ship.

7th. By reversing the bow-screw the ship will stop while both screws are working, so that by the action of the bow- and stern-rudders, the ship will turn round on her centre either way without moving either backwards or forwards.

8th. Great safety will be ensured by working the bow- and stern-propellers with separate engines; for should either of the engines or screws get disabled, the other will be able to propel the ship at about four-fifths of her speed to the end of the voyage.

I believe that by applying engines and propellers in this manner at each end of a vessel, say of about 600 ft. in length, with 45 ft. beam, and allowing, say, 600 h.-p. for the stern-engines and 400 h.-p. for the bow-engines, an average speed of 400 knots per day might be obtained, and the passage between Liverpool and New York would be reduced to an average of from 7 to 8 days.

A ship with its machinery arranged on this plan, would work with comparatively little pitching in a heavy sea, because the weight of water in the screw-tunnel at the bow would prevent the bow from rising too suddenly, and when the bow is up and partially or completely out of the sea, the water would run out of the tunnel and lighten

the bow, so that it would dip more easily and not so deeply when going down again.

Another great advantage obtained by this arrangement, will be the additional cargo space gained along the centre of the vessel. The entire middle part of the ship will now be available for saloons and cabins, free from the unpleasant vibration caused by the engines and the screw-shaft, and be relieved from the disagreeable odours of the oil and tallow used for the machinery, and from the noise of emptying the ashes at night, &c., &c.

A ship constructed on this plan would not require above two-thirds the draught of water that is necessary for long narrow ships with a single screw. In any ship that requires 500 h.-p. or upwards with direct acting engines, the screw-propeller requires to be 20 feet diameter or upwards, and consequently the ship's draught of water will be 23 feet or upwards so as to get the screw well immersed; whereas with a screw at both ends of the ship, two 14-feet screws would give the same propelling surface as one of 20 feet, and would only require 16 or 17 feet draught of water. When screw-ships are in a heavy sea, the screw is often partially or wholly out of the water and has then no propelling power. In long heavy ships, one cause of their success arises from their momentum, which when once raised, any ordinary irregularity on the surface of the water is gone through without being felt, but when the sea is so rough as to cause the screw to be frequently out of the water, it materially retards the momentum of the ship; whereas when a ship has a screw at each end, when one of them is up and out of the water, the other is sure to be well immersed, and thus keep up the momentum of the ship, and her speed would not be retarded as in the other cases.

Captain Hoseason, R.N.: Mr. Griffiths is a gentleman well known to us all as a great improver of the screw-propeller, and the present patent brought before us will, I conceive, lead to its nearly universal adoption, for it will greatly develop, I imagine, both the sailing and steaming qualities of all vessels to which it may be applied. Mr. Griffiths has directed our attention to the fact of the great and rapidly increasing length of steamers—formerly a length of only four times the beam was deemed sufficient, now 6, 7, 8, and even 12 times is required—this great increase of length, although most favourable to economy of power, *ergo*, fuel, has been found materially to prejudice the several vessels' steering qualities; great comparative length also has led to a great increase of the tonnage or size of all steamers, and with it, a demand for far larger screws, and this necessitates that steamers should be constructed with great draught of water—a very great disadvantage as a general rule. Mr. Griffiths claims, for his invention, eight advantages over the ordinary propeller, and I think he proves them clearly. But I believe that there is another advantage which he has entirely overlooked, viz., that his mode of applying his propellers will greatly facilitate the use of canvas whilst under steam. All steamers, either constructed with the screw or paddle, find it nearly impossible to carry after-sail when on a wind, from the tendency that they have to gripe, or fly up in the wind. Now I conceive that the power, as he proposes to apply it, divided between both extremities of the ship, may remedy this great defect, and will thus enable more canvas to be carried when under steam—this combined action of steam and sail leads to a great economy of fuel—for the wind costs nothing, and yet we increase its intensity over the area of the canvas, especially when the true wind is on the quarter or beam. If, for example, a steamer was sailing with the wind on the quarter with steering sails, &c., going 4 knots an hour under canvas alone—

you could easily accelerate this velocity to 8 or 9 knots, with the use of a very small portion of steam, considerably less than that two boilers produce out of four. This accelerated velocity to 8 or 9 knots would oblige the taking in of all the steering sails and the bracing sharp up, but the intensity of the pressure of the wind on the area of the remaining canvas would be increased greatly by the accelerated velocity of the vessel through the water, and is thus made to act as a stronger motive power. Unfortunately the tendency of all steamers to gripe, renders all after-sail under these conditions nearly unavailable, at least I found this to be the case in experiments conducted by me over 75,000 nautical miles, and with no one to limit my expenditure of fuel.

It is important to bear in mind, when we are considering the value of Mr. Griffiths', propeller, that a mean average velocity of 8 or 9 knots an hour can readily be obtained by the combined action of steam and sail, and that the odds are always about three to one—except in opposing trade winds—that some canvas can be made to stand. But our present large screws militate sadly against a vessel's sailing qualities, when under sail alone, and prevent the carrying of after-canvas when under steam and sail.

I have mentioned a velocity of 8 or 9 knots, as that I imagine to be a good service speed for merchant vessels and men of war. With fast mail-boats going 12 or 13 knots an hour, the change of the direction of wind, would be too great to render canvas often available, unless going with the wind dead aft.

The economy of Mr. Griffiths' new propeller would be very great whilst running before a monsoon or trade wind, for when in its place, available at a moment's notice, under canvas alone, it would *not* retard the vessel's velocity in any material manner. Now the value of having steam in a ship, is the ability which it gives to keep up any determined average velocity, but if the sails will alone do this, we need not apply steam. We know that, in a run from Aden to Bombay, or from Point de Galle to Achen Head in the S.W. monsoon, the wind alone will drive a vessel at the rate of 8 or 9 knots an hour, even when only jury-rigged; and with the wind, a current of from 2 to 4 knots an hour is usually running, so that such vessel, if not impeded by her screw, may count on passing over the ground at the rate of 10 to 12 knots an hour.

As much science is required in the handling, as in the construction of steamers, and private companies and the Board of Admiralty are simply spending thousands a year unnecessarily when they neglect seriously to attend to these matters. I am one of those gentlemen who have been at issue with Mr. Reed on a very important point. He wished to lead you to imagine that a short ship can be made to go as fast as a long ship. If so, the whole Institution of Engineers, and the ship-builders are wrong in constructing ships, for they are going on increasing the length, and thus making a small power do an enormous amount of work. If Mr. Reed had confined himself to the advantage it is to a man-of-war to be short, for the facility of turning, that would have been another affair altogether; but we must not allow our minds to be diverted from the most important fact of the value of length. Mr. Griffiths has pointed out to you that as the length *increases*, the action of the screw upon it *decreases*. He has also pointed out that these long ships in the trough of the sea might be entirely at the mercy of the waves, a point in which I perfectly agree, and under those conditions, I think, as the length of ships, on the score of economy, must be increased, Mr. Griffiths is bringing forward a very clever invention to remedy the defect of the great additional length, or the one weak point of the increase of length that I have alluded to. He shows us also that instead of the one screw being 20 feet in diameter, you may have two of fourteen. Now I need not say, for mercantile ships as well as for men-of-war, what a great advantage it would be to be able to go up rivers with such a reduced draught of water.

We certainly are arriving at rather a dangerous point of length in our ships unless we have some new mode of propeller, as Mr. Griffiths proposes, at the extreme ends of the ship. There is an advantage, moreover, in having separate engines. In a ship like the "Devastation," with no masts at all, her safety lies in the number of engines she has got. They say there is no danger because there are two of them. I have taken the liberty to suggest that it is possible that the bearings may be affected by coal dust. In a run of 75,000 miles I never stopped

the ship but once, for injury to the engines, but I stopped her repeatedly, for the coal dust getting into the bearings and causing them to become heated. In the case of Mr. Griffiths's ship, if a heated bearing was to happen aft, it would not probably happen forward at the same time.

Captain WELLS, R.N.: The "Devastation" has four engines, a pair of engines to each screw.

Mr. GRIFFITHS: Another curious fact with regard to this vessel (the "Alpha") is, that when she is towing with the after-screw, going down the river, she pulls an enormous wave behind her, but when she is working with the forward screw, there is no wave at all; the water is quite smooth. In a boat going in the canal with only one screw, the suction of water is so great that she appears as if she was going up hill altogether.

Captain WELLS, R.N.: What suction is there by working the stern-screw?

Mr. GRIFFITHS: She sucks the water in by the screw. All the vessels in the canal go in this way, and the wave follows, whereas if you work by the bow-screw there is not the least difficulty of that kind. The fact is, we know very little about screw propelling; there are a great many things to be found out as to the effect of the resistance to bodies moving through water.

Captain WELLS: Might I ask what differences of speed you get in working singly either the bow or stern screws?

Mr. GRIFFITHS: As I have stated when we experimented with the model, when the two screws were working together we got 5·8; then when the stern-screw was worked without the tunnel, as a common screw, we got 4·62, and when it was worked in the tunnel 4·92. With the bow-screw alone we only got 4·2.

Captain WELLS: Then the difference is between 4·2 and 4·6. How do you turn her in her own length?

Mr. GRIFFITHS: I work one engine to throw the water out ahead, and the other to throw the water out astern.

Captain WELLS: You go ahead with one and astern with the other? Are you of opinion that if you were in the trough of the sea you would turn her in the same way?

Mr. GRIFFITHS: Yes.

Captain WELLS: With the two screws?

Mr. GRIFFITHS: One screw is quite enough to turn her in the trough of the sea.

Captain WELLS: In double screw-ships and in the "Waterwitch" it has been found to answer very well in still water, but directly you get into the trough of the sea, neither the one nor the other will do it.

Mr. GRIFFITHS: The "Waterwitch" has no leverage. The water coming out at the sides, all the leverage she has, is half the beam of the ship, while we have the leverage of the whole length of the ship.

Captain WELLS: As I understand it, the principal advantage of this system is small draught of water; the speed gained is not so very great.

Captain HOSEASON: Another advantage is that the momentum will be kept up, as both screws will never be out of the water at the same time; consequently there is no loss of momentum from the action of the screw ceasing altogether when the ship is pitching heavily.

Captain WELLS: Did you ever hear the results obtained in the American rivers by having the paddles in the centre of the ship?

Mr. GRIFFITHS: I saw that principle tried 30 years ago on the Seine. There were two boats, and the paddle in the middle. They do not go well. The friction, I imagine, is too great.

The CHAIRMAN: I beg to return your best thanks to Mr. Griffiths for his lecture and explanations.

PROPOSED METHOD OF ATTACK IN SKIRMISHING LINE.

By Captain F. G. S. Parker, 54th Regiment.

"The Prussians place the greatest importance upon the skilful conduct of *offensive* " fire-action."

. . . .

"For many years they have spared neither expense nor trouble in grounding " their whole infantry in every description of firing fighting."

. . . .

"In order to stimulate 'apell'" [*i.e.* disciplined *intelligent* obedience], "and enforce " discipline in firing, the assembly and expansion of small bodies in far more extended " fashion than the regulations at present prescribe must be practised, in addition to the " persevering performance of the regulations already contained in the instructions."*

Preliminary Remarks.

These remarks of Field-Marshal the Duke of Würtemberg, so exactly express the purposes I had in view in designing the following simple formation; they so accurately prescribe what our own infantry require to be taught, that I make no apology for quoting them as the text of this short paper.

All extended formations as yet introduced to notice, appear to me inapplicable to the *daily drill* of our Army. Our regiments are so weak when on the home establishment, that after deducting the requirements of detachments, guards, fatigues, &c., it is rarely (excepting during the periods such regiments are at the Curragh or Aldershot) that a sufficient number can be mustered for a really efficient parade on the present system of advancing by alternate half-battalions; or of skirmishing with the prescribed supports and reserves.

I need scarcely say more upon this, than that I have myself in Ireland seen a head-quarter parade, for many months, average four companies of single rank with only from sixteen to twenty *men* per company!

At Aldershot and the Curragh, where these drawbacks do not exist to such an extent, I have never found the men well in hand, skirmishing as at present laid down; the skirmishers get excited, and continually rush from one extreme to the other—they open out too much, and so lose the power of quick concentration, or they crowd too much (especially if cover be frequent) and so expose themselves to artillery fire. The line of a single company extended, is too great for the eye and voice of the Captain to control, more especially when a wind is blowing and firing going on; and the unity of action which is so

* "System of Attack of Prussian Infantry," by Lt. F.M. Duke of Würtemberg. Translated by Captain C. W. Robinson, R.B.

essential between the skirmishers, supports, and reserve, has to depend upon the intelligence of two or three Captains instead of on the judgment of one.

If it be said, that the system of skirmishing in double companies, and the general supervision of a Major counteracts these defects, I reply, 1stly, that the supervision of a mounted Officer ceases to be *promptly* effectual, directly the smoothness of a drill ground is exchanged for the ever-varying extent of broken, woody, or rolling country; and 2ndly, that men never work *very well* in double companies, for they only *hear* words of command from other than *their own company Officers*, and in extended formations it is of prime importance that the men should *recognise* the voice that orders them. On a regimental parade-ground, men obey the command of *any* Officer, provided his voice be powerful: but, during the excitement of a sham fight (and how much more so during an actual engagement) unless the *tone* be recognised, the order is apt to fall upon unheeding ears.

Proposed Formation.

The formation which I now submit to notice has these advantages:—

1. It can be as efficiently practised by a single company as by several; by a weak regiment as by a strong one; and by one or more regiments in brigade.

2. It habituates the men to work in the loosest as well as in the most compact order.

3. It teaches the company Officers to handle their men on an extended and ever-varying front. Each company is under the eye and complete control of its Captain, so that every advantage can be instantly secured, and every disadvantage can be rendered as nugatory as possible.

Battalion in Line.

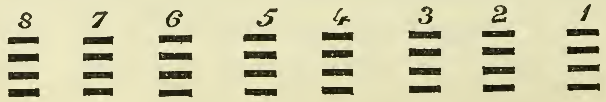
A.

I have given the manœuvre from line only:—but it is obvious that it (C) can be assumed with equal facility from any column formation.

When within 1,600 yards,—or as much nearer the enemy as the nature of the country, &c., will allow, the Commanding Officer gives the order "*Advance in column of sections from right* [2nd, 3rd, or left sections] *of Companies.*"

Advance in Column of Sections from the Right of Companies.

B.



Hereupon 2nd, 3rd, and 4th sections make a half-right turn [or

respectively half right and left or half left] receiving "front turn" from the respective Section Commanders, and advance as B.

Upon arriving within the enemy's fire, the Battalion Commander [or Major, if advancing by half battalions] orders "*Leading sections, skirmish;*" upon which the Captain of Right Flank Company gives "Leading section from the left extend; inner sections half-right "turn;" at the same moment the Commander of *Rear* (4th) section halts his section.

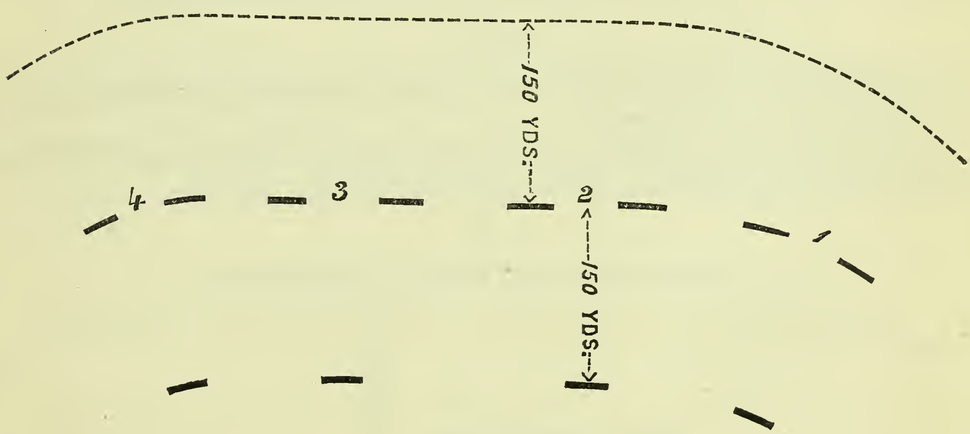
Simultaneously the Captains of the other companies perform the same manœuvre, but with this difference—the left flank company extends its leading section from the *right*, and its 2nd and 3rd sections make a half-left turn:—the leading sections of the other companies extend from their respective centres, and their inner sections receive the order "outwards half-turn."

The rear sections are halted by their respective Commanders same as the right flank rear section.

Second and third sections, when respectively in rear of centre of right and left, half of skirmishing section get from their section leaders "Front turn," and step short, or halt till the skirmishers are 150 yards a-head, when they continue the advance.

Half [or entire] Battalion advancing in a line of Company Columns.

C.



Position in the line of each Company-column on completion of the order "Leading sections—Skirmish."

The rear section of each company resumes its advance at 150 yards distance from, and covering the interval between 2nd and 3rd sections.

The two flank sections on receiving the order to extend incline to their outer flank, the left file in the one case, and the right file in the other, turning to the front, and commencing the extension when opposite the point that was the outer flank of the section before the extension.

It may, at first sight, appear a drawback that in this formation if the heads of the columns of sections (B) are the correct distance apart [*i.e.*, $\frac{8 \text{ number of files}}{10}$], there will be a skirmisher to every two (2)

paces on first extending,—but in an actual advance (other than a very short one on a barrack-square) such accuracy is impossible; and it is evident, and in the present case it is intended, that the respective company-columns open out to irregular distances from each other according to the nature of the ground,—so that in practice there will not be less than (3) three paces interval, which is a useful minimum; and when necessary, this distance can be readily increased.

Furthermore, against this possible objection, the following advantages are to be balanced.

a. Skirmishers can be re-inforced, relieved, overlapped from either flank, or the enemy misled by a refused flank of echeloned skirmishers, or sections.

b. If advisable so to do, line can be readily formed.

c. Groups and fours of skirmishers, and groups or section-squares, readily formed if threatened by cavalry.

d. The front can be readily extended or contracted.

e. A great depth [an important point in an army, which, like ours, must generally fight a defensive-offensive battle] obtained with a minimum exposure to artillery fire.

f. The *skirmisher-swarm* kept well in hand, since each section is under the eye of its leader, and each company well under the command of its Captain, whose *general* place will be with the two supporting sections until the whole are absorbed in the skirmishing line.

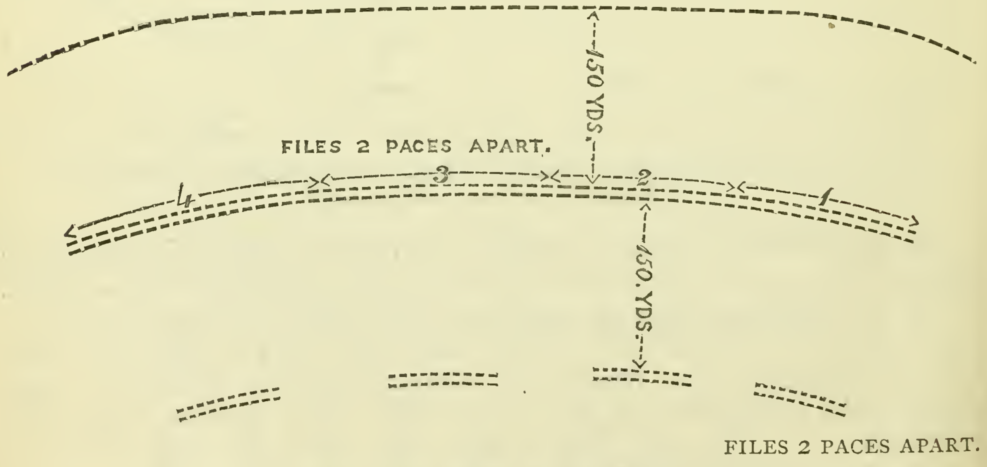
Note.

1. Whenever halted under fire, the three supporting sections should, as a general rule, lie down.

2. In advancing under fire, the three sections should march in loose order, *i.e.*, with about two paces interval between the files.

D.

Skirmishers in single rank 3 to 5 paces apart.



Second form of Manœuvre C, viz.:

Position of line of Company Columns when advancing under fire.

3. In this, and in every mode of extension, the rear rank man

should invariably be on the *left* of his front rank man when extended.

4. Skirmishers when recalled, should always clear the front and run in by the *nearest* flank. Thus in C, all the skirmishers, except those of the left flank company, would run in by the right flank.

5. Skirmishers should fire on the knee, or lying down, as occasion best serves; the present system of running to the front to fire is bad, as it "pumps" them, and endangers individuals in a long advance being shot by any men of less wind and speed, who must lag.

6. Individual skirmishers should be taught to rush forward only when they see good cover within a *reasonable* distance (say 25 yards as a maximum) the Section Commanders giving order if a longer rush has to be made.

7. For skirmishing and outpost duty, a whistle should be used to direct men when out of actual eyesight, or easy voice-range. There have been, for many years, whistles constructed whereon the whole of the bugle calls can be sounded; if this be thought too complicated an instrument for rough and ready use (though why should it be so considered?) any simpler kind might be adopted. In the campaign of 1866, the Prussian Officers provided themselves with common dog whistles and wore them attached by a piece of string, for these duties. The bugle is too loud for the secret and instantaneous direction of *skirmishing sections*.

N.B.—Since submitting the above to notice, I have been informed that a similar idea has been printed by General McDougall, and put into practice by the Austrians. Neither of these statements were known to me, nor to any of several *reading* Officers to whom I have shown my manœuvre: I therefore still think it advisable to bring it to notice in the pages of the "Royal United Service Journal," that discussion may be invited, and that my idea—if it prove really practical—may not lie useless.

NOTE ON ALIGNING THE SIGHTS OF ORDNANCE WHEN LAYING FOR AN OBJECT.

By Lieutenant H. H. GRENFELL, R.N., H.M.S. "Excellent."

THERE are two different methods of aligning the sights of a gun on any object; in the Royal Navy, the captain of the gun aligns the sights from a position in rear of the gun slide, and at a considerable distance from the breech of the gun; while in the Royal Artillery, the alignment is obtained by placing the eye close to the hind-sight of the gun.

As this difference of method results in an actual difference in the laying of the gun, the "line of sight" and consequently the "line of fire," being always directed somewhat lower in the latter case than in the former, it may be as well to endeavour to discover the cause of this difference, and to show which system gives the nearest approach to a correct alignment.

The "nearest approach," because however great the powers of the eye, it exhibits certain defects as an optical instrument which preclude the possibility of perfect accuracy being obtained.

It is well known, for instance, that when several objects are at different distances in a direct line from the eye, a distinct image of only one of them can be received at the same instant—in other words, the eye can only be brought to a focus on one of them at a time—and that the other objects between and beyond, are actually doubled, and consequently appear hazy and indistinct.

Furthermore, when an object is brought close to the eye, this indistinctness and haziness are manifested in a greater degree, and when placed very close, the eye is incapable of receiving a definite image of the object, although fixed upon it.

We may conclude then—

That the more nearly different objects in a direct line from the eye lie close to one another, the more distinct will be the images of all of them produced upon the eye.

That the farther they lie apart in this line, or the more nearly any of them are approached to the eye, the greater will be the difficulty of obtaining a distinct image of all of them at one moment.

To apply these facts to our subject:

First let it be said that a regulation-sight is one where the line of sight is taken along a plane which bisects the depth of the notch in the hind-sight, touches the top of the fore-sight, and passes through the centre of the object; such an alignment being known as a "half" sight (Fig. 3).

Just, then, as the eye is placed close to the hind-sight does the difficulty of obtaining a clear and distinct image of this latter increase, and consequently that of estimating the point half way up its sloping

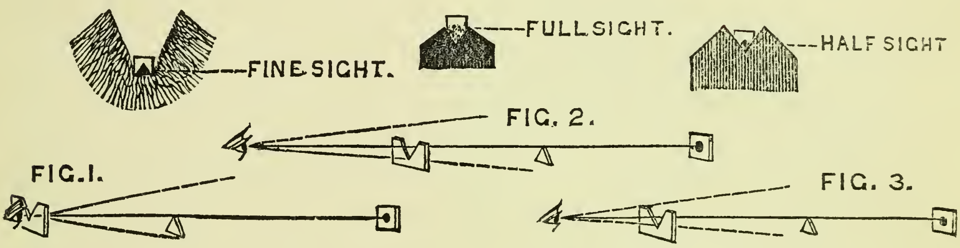
slides through which the line of sight should pass for a "half" or regulation-sight; hence the tendency is for the eye to seek and be guided by the easily distinguished *bottom* of the notch, with the result that what is known as a "fine" sight is taken, or the gun is laid *too low* (Fig. 1).

If, however, in order more clearly to see the hind-sight, the eye be removed to too great a distance in rear, then the fore-sight becomes indistinct, and the eye in order to be thoroughly sensible of it, is apt to bring it too far up into the alignment, and a "full" sight is the result, or the gun is laid *too high* (Fig. 2).

The proper position for the eye, which must vary with different powers of sight, but can be easily found by trial, would be at such a distance in rear, that the maximum distinctness is given to the hind-sight compatible with retaining a clear image of the fore-sight; then the "half" sight required can be more readily obtained (Fig. 3).

These conclusions, which can easily be verified by experiment, show, that the method in use in the Royal Navy is the more accurate of the two.

The practical difference is small, but where great accuracy at short ranges is desirable, as in testing armour-plates, &c., a knowledge of these facts may prove of value.



MAP OF THE BLACK SEA AND CAUCASUS TO ILLUSTRATE SIR A. CUNYNGHAME'S LECTURE.

Stanford's Geog. Estab. London.

MAP OF THE B

Plate XXXIX.

The Journal
OF THE
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Vol. XVII. 1873. No. LXXV.

LECTURE.

Friday, June 13th.

Colonel The Right Hon. Lord WAVENEY, F.R.S., A.D.C. to the Queen, in the Chair.

ON "THE EASTERN CAUCASUS AND DAGHESTAN."

By Lieut.-General Sir Arthur Cunynghame, K.C.B. Colonel, 36th Regiment.

Surrounded as I find myself by so many persons of consideration and intelligence, and by Officers of distinction, I own it is not without feelings of some apprehension that I deliver this rough recital of my experiences during my last trip in Asia.

The merit, if any, which I lay claim to, is that of having undertaken this journey in a country where few Englishmen have preceded me, and therefore freshness and novelty may give it some interest.

The general features of our expedition comprised a run through Europe to Constantinople, Southern Russia, and the Crimea, the Cis- and the Trans-Caucasus, with a return home by the southern shores of the Black Sea. I propose mostly to dwell upon those places less known, such as Daghestan, &c.

On the 9th of June, we landed at Antwerp, and proceeded thence *viâ* Brussels, Aix-la-Chapelle, Cologne, and Munich, to Vienna. We here took advantage of the opportunities which were placed in our way, by His Excellency Lord Blomfield, of seeing as much as possible of the military establishments of Austria, and it is satisfactory for me to think, especially after a recent visit to Woolwich, that we have very little to learn as to military science from that country.

Leaving the interesting and beautiful city of Vienna, we next visited Pesth, where, since its emancipation, giant strides of improvement are everywhere evident. Pesth bids fair to become one of the handsomest, largest, and most thriving cities in Europe.

Passing through Temesvar, we embarked at Basiach, on the Danube, and threading the Carpathian mountains, in two days reached Giurgevo. Here we struck north to Bucharest, a city covering as much ground-space as Paris, but so little known in the west.

Returning by Rustschuk, we proceeded to Schumla, where Ali-Kerim-Pacha presented me to his army corps. Many years since I had commanded a division of the Sultan's troops, and it is with the greatest

interest that I can bear testimony to their general improvement in appearance, physique, activity, and the cleanliness of their camp.

Leaving Schumla, we reached Varna. The last time I saw this roadstead, now nearly deserted, it had contained between 500 and 600 ships, the fleet destined to attack Sebastopol. Leaving Varna, we landed at Constantinople. There are so many here present well acquainted with this beautiful city, and who could describe it better than myself, that I will only remark, that the rapid strides which are being made in the improvement of the city, make me think that ere long, it will equal in cleanliness, as it now surpasses in beauty, almost any city in Europe; the development of its naval and military organization is, moreover, surprising to those who, like myself, knew it nearly 40 years ago.

At this stage of our journey, a stronger interest surrounded us, as much, if not all that I saw, with the exception perhaps of the Crimea, was new to myself, as it would be to other Englishmen.

Leaving Constantinople in a fine vessel, nominally a trading steamer, we started for Odessa. I may mention that these Russian trading steamers are officered by the Imperial Navy, thus keeping her naval Officers in training, and giving those that are energetic, the advantages of considerable extra pay and allowances.

On leaving the Bosphorus, the Russian Consul-General presented me, by order of the Russian Ambassador, with letters for the authorities in Southern Russia and the Caucasus; these we found of the utmost advantage in our subsequent journey.

I may here mention that we were generally informed that the journey we proposed to take in Daghestan, we could never accomplish—that we should be lost in the mountains. I own that it was not without some misgivings on the subject that we determined to proceed.

On the third day, we landed at Odessa, where, no sooner was it known that I was an English General Officer, than every Custom-house formality was immediately dispensed with, and every attention was shown me. Odessa is a cold, bleak, and comparatively new commercial city; its great industry being that of shipping corn for England. The inventions for sifting and airing grain are far behind those in use in America, no steam machinery existing for this purpose; but as fine quays have been erected at a large expense, vessels of 3,000 tons can easily lie close to the piers.

We were naturally very desirous of visiting Nicolaief, that Russian arsenal which is creating so much interest in England.

We left Odessa at 12 p.m., and early on the following morning, passing the Kinburn Spit, we entered the River Bug. The channel was represented to be about 21 feet deep, the bottom soft mud. The river narrowed gradually as we approached Nicolaief. About seven miles below that city we passed three powerful forts, one on an island in the centre of the river, and one on either bank; these were armed with heavy Krupp guns. We disembarked near the junction of the Bug with the River Ingul, the arsenal being quite hid from our view by the range of hills upon which the town stands. Subsequently we had a good opportunity of seeing the arsenal itself.

Yesterday's *Times* gave an account of the launch of an ironclad of 480 horse-power, "The Novgorod;" it may therefore be considered very bold of me to state that, I cannot yet look upon Nicolaief as an iron-clad constructing arsenal. How this vessel has been constructed I can only surmise; her plates may have been brought by sea from Western Europe, or may have been sent by rail from St. Petersburgh; but I can scarcely believe that they were rolled in a genuine way in Nicolaief itself; and without a large command of iron and coal on or near the Black Sea, it is almost an insurmountable task for Russia to construct a really powerful ironclad steam fleet such as would endanger Constantinople.

We may look at the difficulties and immense expense in iron ship-building which, with all our advantages, are entailed upon us; we have skilled workmen, iron in close proximity with coal, for years a gradual progressive knowledge of this art; and, yet by what enormous energy alone are we enabled to surmount them. There may be coal and iron on the River Don, but as yet, this industry is in such a state of infantine development, that the rolling of such huge plates as form the sides of the "Devastation," is altogether out of the question; and what I saw in the arsenal on the Ingul, gave me the impression that some of our large mercantile ship-building establishments could far surpass it.

When we remember, moreover, the magnificent ironclad steam fleet now dotting the Bosphorus, under the walls of the Seraglio, it is futile to imagine that the Russians can for many years to come, produce such a vessel on the shores of the Black Sea as could exist under the fire of such monsters as the Sultan has collected for the defence of his Empire. Nor can I for a moment believe that the Turks could be so infatuated as to sanction the passage through the Dardanelles or the Bosphorus of any such vessels as would be likely to be injurious to them. My belief is, that it must be a very long time ere such a fleet could be constructed on the Ingul, as would cause us or our friend the Turk, any great amount of anxiety.

We returned in a crowded vessel to Odessa, but such was the kindness of the Captain (an Officer of the Imperial Navy), that, himself sleeping on deck, he relinquished his cabin to us.

On the following day, we embarked for the Crimea, touching at Eupatoria, which, on my last visit, was threatened by the grand fleet of 600 ships, when we attacked Russia.

In the afternoon, we reached Sebastopol, the desolation of which, was more remarkable than when I had left it, on the breaking up of the grand army in 1855. From 80,000 inhabitants, Sebastopol has now dwindled down to 8,000.

It is contemplated by many that Sebastopol will become a grand mercantile harbour. When the system of railroads from the corn-growing countries to the east, west, and north are finished to this port, its perfect security and depth of water, offering facility for vessels of any tonnage to approach the quays, and thereby preventing a second embarkation of corn, (as is now the case from the Sea of Azof,) a vast saving of expense will be effected, and the city which stood as the menace of

Europe will be converted into one of the largest peaceful mercantile emporiums of the world.

We visited the well-remembered trenches and the battle fields of Inkerman, and saw the spots where many a friend was laid low. The mausoleum erected by the Russians in the shape of an Egyptian pyramid, is solid and handsomely constructed. That, as well as the French cenotaph, has the advantage of gathering together in one spot, if not the actual remains of all those soldiers who died for their country, yet concentrates the recollections of their glorious deeds, whereas the vain attempts to preserve the monuments of our brave countrymen scattered over the wild plains where they fell, are almost impossible of achievement.

We visited Alma and Balaclava and the valley of Inkerman; but it is impossible in the space of this lecture to dwell upon these interesting fields, or upon beautiful "Bagtchi-serai," the burial ground of 80,000 Russian soldiers.

We then embarked for Yalta, and saw the palace of Prince Woronzoff at Alupka, and the Emperor's palace at Lavadia, and thence proceeded to Kertch.

This fortress has become most interesting. I was astonished at the immense fortification which the Russians have here erected; it is said to be a pet work of Todleben, and to have already cost 22,000,000 of roubles, and for ten years the daily labour of 2,000 men. It appears doubtful to me, however, if any circumstances could arise, whereby this great outlay could meet with commensurate advantage. I had some opportunities of seeing the outer works of the fort, but could not obtain admission into the interior.

Re-embarking at Kertch, we sailed past the fort of "Yenikale," between Europe and Asia; the Strait here is very narrow and easily defensible.

The Sea of Azof is muddy, shallow, and subject to constant storms; we had a deluge of rain, many of the passengers and the Captain were attacked with cholera, and we had a most uncomfortable passage to Taganrog. Here we came upon the great arable plains of Eastern Russia, one farmer possessing 40,000 acres of corn lands in his own hand. It was satisfactory to see the immense number of English agricultural machines which were being imported into that country.

We next embarked on the River Don, and were four days going up that river. We had an opportunity of seeing the Don Cossacks, as fine an irregular force as exists. Their system of service depends upon patriarchal principles, for whilst each in turn is devoting his services to the Emperor, the rest are occupied in cultivating their lands. There are 80,000 Cossacks of the Don, a proportion of artillery as well as cavalry: a large number are always on duty at St. Petersburgh. They are excellent horsemen, active, intelligent, and trustworthy, and their power of enduring either heat or cold, is almost incredible. In the period of time to which this lecture is restricted, it is impossible for me to give an account of the principles upon which the armies of the Cossacks of Russia are regulated.

At length we reached Kalach on the Don, and passed by rail to

Tzaritzin on the Volga. Here it is supposed was an ancient canal, by which the Genoese—those wonderful pioneers of commerce—took their small vessels, and passing from the Mediterranean through the Black Sea by means of the Volga, descended into the Caspian, and formed settlements at the base of the Caucasus mountains, the descendants of whom, although changed in their religion from Christianity to Mahomedism, are still residing in their mountains.

At Tzaritzin, we embarked on the Volga, and had a most uncomfortable passage down the river to Astrakhan.

It was at Astrakhan that Peter the Great first built his naval dockyard on the Caspian; and the boats which he built with his own hands and his basket of workman's tools are still shown. Peter had a sure prescience of the future Eastern conquests which Russia would make. True to Russian policy, the Caspian arsenal has now advanced towards the shores of Persia, to Baku. Near Astrakhan is a large Mongolian Kalmuck settlement, 80,000 of whom inhabit a district on the western bank of the Volga; they are the only Buddists in Europe who worship in Chinese temples, and inhabit Mongolian tents, so ably described by Colonel Yule in his travels of Marco Polo. They drink the brick tea with fermented mare's milk, and resemble the Nomadic tribes which I had seen in the north of China and the Thibetan valleys.

The wealth of the cathedral at Astrakhan is fabulous; pearls and diamonds in profusion being shown to us. Here, there used to be considerable trade with the East, and with India, which latter appears now entirely extinguished.

We now entered the Caspian Sea, the greater part of which is very shallow. It is so stocked with sturgeon, that the value of this fishing is said to be about £2,000,000 sterling per annum; wild ducks are in such profusion that they sell for $1\frac{1}{2}d.$ each, and pheasants are said to abound on the islands at the 60 mouths of the Volga.

The eastern side of the Caspian is little known; it is inhabited by a warlike race of Kurds. The Russians have established themselves on some isolated points, of which the fort of Krasnovodsk is an example, and it is hence that a column has started for Khiva. On the western side of the sea, are some interesting towns, especially that of Derbend, where an ancient wall partly exists, resembling that of the great wall in China, and also Baku, the seat of the eternal fires, whence, Marco Polo relates, petroleum, for lighting purposes, was carried as a regular industry throughout a large portion of Armenia.

We landed at Petrovsk, and, after some difficulties, struck into the mountains to visit Daghestan and the fighting grounds of the renowned Schamyl.

We were now fairly in the Caucasus; and perhaps this is the proper moment to consider the Russian army which is kept in that division of the empire, and which, to our ideas, seems very large, as the country is not so extensive as either the Bombay or Madras Presidency.

The Russian army in the Caucasus consists of—

Cavalry	3,700
Infantry	131,500
Artillery	8,000
Engineers	2,300
Establishment	5,800
Total	151,300

Steamers on the Caspian	20
,, ,, Aral	4
,, ,, Black Sea	29

The greater portion of the eastern mountain districts, or Daghestan, was only subdued some ten years since; here the renowned Schamyl ruled with determined vigour, resisting for nearly twenty years the mighty monarch of more than 1,200,000 soldiers—a force of at least 120,000 men during all this time being constantly employed—while Schamyl's army never exceeded 20,000 native Circassian warriors. This unexampled feat requires some consideration to render it credible, but shows how an impregnable country, composed of natural fortresses, is able to resist the most determined and skilled armies.

To no small degree was our interest augmented when told by the Russian Generals that only two English travellers had ever previously penetrated into this country. I need not now dwell upon the hardships and difficulties which a journey into these mountains entailed upon us. At length we reached Guinib, the last stronghold of Schamyl. Guinib is a natural fortress, 4,000 feet above the valleys which surround it, but little larger than Gibraltar, its sides, the naturally scarped rock, impossible to ascend. Here great heroism was displayed on either side; at an immense sacrifice of life, the stubborn Russians, under the command of Prince Bariatinsky, obliged the heroic Schamyl to deliver up his sword.

Opposite to Guinib is the country of the Kasi-Kamouks. They are the lineal descendants of the Genoese, to whom I have previously alluded; they are equally skilled in gold and silver work as were their Christian progenitors in Italy; none can now excel them either in London or Paris in their adornment of arms or in jewellery; and it was by these men that the soldiers of Schamyl were provided with their best arms. One of the most remarkable features of that war was, that up to the date of the Crimean campaign, no army of civilised Europe had been universally armed with the rifle, whereas there was no soldier who fought under Schamyl but carried a rifled weapon; this fact alone would account for the wonderful resistance made by that national army.

From Guinib, we passed into Honsak, the command of General Prince Nakashudjee, who repeated all the attention and kindness of General Kamaroff; thence to Bodlith, where General Prince Chaf-cha-vadsey—descended from the Royal Family of Georgia—and General Prince Orbeliani, commanded. Thence we crossed the mountains towards Weden; here, we saw the almost incredible feats performed by the mounted Tartar horsemen, who, although on the edges of pre-

cipices, riding at a furious gallop, stood upon their saddles, fired their muskets beneath the bellies of their horses, or, leaning down, picked up pebbles from the heath. On our road to Weden, we passed that gorge in the mountains where Prince Woronzoff suffered his disastrous defeat.

At Weden, Prince Errinsoff received us with the usual kindness. We were now in the real district of the Checkengis or Circassians. The men were fine-looking fellows, and the women handsome. Since the conquest of this country by Christian Russia, the purchase of women is almost impossible.

Here again is the seat of those fierce bands of the Amazons who, regardless of all danger, with shirt of mail and casque of steel, fought in the front of the battle, obtaining immense proficiency with the bow and the spear, which they wielded with such dexterity.

Our ride through the mountain was now ended, and henceforward we obtained the posting carts of the country. Remaining a brief time at Vladi-Cavcas, the capital of the Northern Caucasus, we prepared to cross the mountains into Asia.

The first object on our passage through the Pass of Dariel was the magnificent mountain, Kasbek, perpetually covered with snow; it is 1,000 feet higher than Mont Blanc, and it is satisfactory to record that the first person who surmounted the difficulties of the ascent of both Mounts Kasbek and Elbwitz was an Englishman, Mr. Freshfield.

It was at the foot of Kasbek that we met his Imperial Highness the Grand Duke Michael, from whom, subsequently, we received the utmost attention.

We next proceeded to Tiflis, which we reached in the early part of September. It is impossible here to enter upon more than the salient points of our journey, but perhaps you will allow me to speak of the subject of the railway system of these countries, which is creating such an interest in Europe.

A railway is now completed from Poti, on the Black Sea, to Tiflis, and is to be at once proceeded with to Baku, the new arsenal on the Caspian. A rail is projected to connect Taganrog by Stavropol and Derbend, by the shores of the Caspian Sea, to Baku, and from Bakou it is contemplated to extend it to Teheran. It is advocated by many that we should subsidize the scheme which is proposed, of connecting Constantinople by a line running south of Trebisond towards Mount Ararat and Erivan, and thus to Teheran, and that prolonging this line by Herat and Candahar, we should join it at Mooltan, with the railway system of India.

Again, the scheme of Monsieur Lesseps, by which communication between Europe and India should be made *viâ* Moscow, Samarkand, and Cabool to Peshawur, and the line of the Euphrates Valley, have lately been brought prominently to our notice.

It cannot be otherwise than with feelings of great respect that we look upon a scheme advocated by so renowned a man as Lesseps, who has united the navies of two worlds; but at the same time, bearing in mind the enormous length of the line which he advocates, and which in its execution would probably require a sum of £50,000,000

sterling, as also the great military objections of being dependent upon the good auspices of Russia for our overland communication with India, I really think we may dismiss this line of communication entirely from our contemplation.

Again, the line through the north of Persia, for almost the same reasons that I have adduced respecting that through Russia, cannot but meet with grave objections. The one would probably equal in expense the other, and would be open to almost the same military objections, as the armies which could readily be brought from Russia by the Caspian from the Volga, and by the line of rail to which I have alluded from Taganrog, would materially frustrate,—should we be at war with that Power,—all endeavours on our part to succour our armies in India through the assistance of a speedy overland route by the north of Persia to that country. I cannot, therefore, but believe that if it is conceded that an overland line of rail should be made to India, the line by the Euphrates valley from Aleppo to Grain, on the Persian Gulf, is the one which it will be most advisable to adopt. No doubt it could not be considered complete until a connection was formed between Aleppo and Constantinople, and also by Bagdad through the south of Persia to Kurrachee (of course I premise that Aleppo has been joined to Alexandretta). But the advantage of the Euphrates line is, that the portion from Alexandretta to Grain being completed, this portion could be at once utilised as the assistant to a speedier transit, and thus, should any unforeseen accident happen to the Suez Canal, we should not be left, as our only alternative route, with that of the Cape of Good Hope.

We were surprised at the size and prosperous appearance of Tiflis, the capital of the Caucasus. In its centre is the palace of the Governor General, the Grand Duke Michael, brother to the Czar, and who receives £70,000 per annum to enable him to keep up the dignity of his position. So little is Tiflis known, or considered, in England, that not even a British Vice-Consul is stationed here.

While at Tiflis we visited Prince Mirsky, who commands an army of about 100,000 men, and Baron Nicolaef. Both were residing at Kadjori, in some mountains above the city, whence a magnificent panorama of the Caucasian range was visible.

The splendour of the view will be understood when I say, that fully half a dozen mountains, each higher than Mont Blanc might be seen rising up at various points.

We then posted south towards Erivan and Mount Ararat, entering some wild arid plains covered with large boulder stones. Even the melon carts had their escorts of armed men, whose muskets were always in readiness.

About half way to Erivan lies Lake Gotcha. There the Armenian monks declare fish can only be caught during Lent.

The appearance of Mount Ararat is sublime. It is nearly 18,000 feet high, and one-third of the mountain is always covered with snow. No person, except, of course, Noah and his family, has ever been to the top. To get there I believe is impossible. The point where the corners

of Russia, Persia, and Turkey in Asia meet, is exactly at the apex of the mountain.

Erivan is a very singular city. The dress and language there are quite in the style of the Arabian nights.

From Erivan we travelled at the base of Mount Ararat, to the Armenian convent of Echmiadzin, not far from the borders of Turkey. It is very ancient, and its manuscripts are 2,500 in number. These are all that remain of a once very large library, which was almost all destroyed in the Persian war. It probably contains a large number of the works of the early fathers, which were mostly written in Armenian. There is also a church with curious architecture, date B.C. 300.

We next proceeded to Sardarabad, and in two days, after much difficulty, reached the town of Alexandrapol. This fort, although almost unknown in Europe, is one of the strongest and largest in Russia, and cost in its erection, no less than 22,000,000 of roubles. It is built to menace Kars, from which it is about seventy miles distant.

We now entered a beautiful district, visiting Akhalkalakik and Akhaltsikh, and passing not far from the mineral spring of Abastuman, visited Borjome, the country seat of the Grand Duke Michael. In his absence, we were received with the utmost kindness by Her Imperial Highness. Thence we posted to the junction of the railway from Tiflis to Poti, passing through the malarious forest of Imeritia.

The vegetation of this district is very remarkable. Vines grow in profuse luxuriance, immense bunches of grapes hanging pendant from the slender branches which entwine themselves round the elm trees of the forest, while cereals flourish abundantly wherever they are sown. The rivers running from the mountains wander through this widely extended forest. These are the far famed streams where Jason sought the golden fleece, and which even to this day are made use of in the same manner to procure this precious metal. The woolly fleeces of the mountain sheep having been immersed in these running waters, the fine gold particles which adhere to them, are carefully picked out.

We had now terminated the arduous portion of our land journey. We had traversed Daghestan almost from end to end, a country scarcely more known in England than by name. We had seen some of the highest mountains in the world, and visited the most beautiful scenery. We travelled in the Caucasus alone 1,340 versts, having ridden a portion of this distance in the crutch-like Tartar saddles of the country, the remaining distance on carts without springs. We had lodged alternately in palaces and pigsties; had eaten alternately luxuries and lived on black bread and stale fish; we had seldom taken off our clothes or slept on other than wooden boards; but all these hardships only enhanced the pleasure with which we had travelled through this almost unknown, interesting, and beautiful country.

The mountains of the Caucasus contain a race of as handsome and sturdy mountaineers as any in the world; the plains are rich with vegetation to a degree scarcely credible, and the mineral rewards which scientific seekers may obtain, are as yet hidden for future research.

The native inhabitants are gentle and phlegmatic; the Russian settlers energetic and very hardy, but rude and uncivilised, the upper

classes hospitable to a stranger to a degree almost incredible; and it was with feelings of gratitude to them, and admiration of this surprising country, that we quitted its shores.

We now embarked once more upon the Black Sea at Poti, the port which the Russians have established for their communications with Odessa, Sebastopol, Nicolaief, and Europe, and whence their railroad commences for Tiflis, their capital, and Baku, their arsenal, on the Caspian. It is most unfortunate for Russia that in place of her last unsuccessful war with Turkey, she had not interested herself to obtain Batoum, which lies about 40 miles to the south of Poti. The bar to the harbour of Poti is extremely dangerous and shallow, whereas Batoum is a natural harbour, which by an extension of the spit of land by a groin or pier, could be made an excellent one.

From Batoum we visited Trebizonde, Karasund, Sinope, and other towns on the southern coast of the Black Sea, all beautifully situated, thus accomplishing its entire circuit, with the addition, moreover, of having traversed a very considerable portion of the Caucasian government, as well as Southern Russia, and, having crossed the Caspian, and visited the borders of Persia and Turkey in Asia.

We concluded a rough and uncomfortable passage, by finding the cholera raging in Constantinople, and were glad enough to re-embark as soon as practicable, and make the best of our way by Syra, Corfu, Trieste, Venice, Milan, and Paris, back to London.

It may be expected that, before closing this lecture, I should say a few words on the military relations between Turkey and Russia. It is frequently supposed that the great aim of Russia is to extend its dominions in Europe, and to annex Constantinople; but there are some reasons which make me doubt this. 1st. The enormous difficulties and dangers which, by insisting upon such a programme, have, and would again ensue to her; and, 2nd. That should Constantinople be annexed to Russia, it is by no means impossible that in consequence of the opposing interests which would arise between the north and the south, a dismemberment of the Russian Empire might follow. It would rather appear to me that the policy of Russia is to extend her dominions towards the east, not to Hindustan, for there the difficulties and dangers which would accrue to her by reason of a European war with a very powerful state like ourselves, are manifest. But by steadily adhering to a policy of never crossing to the south of the Hindoo-khoosh, she might gradually work upon the territories of the Chinese, and by also extending her dominions towards the south from the Amoor river she would annex to her already enormous dominions, highly fertile provinces, richly peopled by very industrious and clever races, who, not warlike, are mercantile, and would probably give her few difficulties in their subjugation. Thus Russia would be to a greater extent and more easily rewarded for her exertions than by any demonstrations that she might make against the nations of the west or the countries attached to them. Not only this, but should she establish a firm government on the Chinese seas, she would be able to cope with the development which the Anglo-Saxon races are making on the opposite side of the Pacific Ocean.

Evening Meeting.

Thursday, 26th June, 1873.

Lieut.-General the Right Hon. the EARL OF ALBEMARLE, in the Chair.

NAMES of MEMBERS who joined the Institution between the 17th and 26th June, 1873.

LIFE.

Lindsay, W. J., Lieut. Rifle Brigade.
Richardson, J. B., Major R.A.
Houstoun, Geo. L., Lieut. Royal Renfrew Militia.

ANNUAL.

Crohan, Herbert, Com. R.N.
Brownlow, Sir C. H., K.C.B., Major-General.
Mitford, John, Lieut. Civil Service Rifle Volunteers.
Alt, J. W., Captain 15th Surrey Rifle Volunteers.

THE EDUCATION, AND PROFESSIONAL INSTRUCTION OF OFFICERS.

By Captain A. B. Tulloch, 69th Regiment, Garrison Instructor, Halifax, N.S.

The Chairman: I have to call upon Captain Tulloch to read a paper on "The Education and Professional Instruction of Officers." I have only to regret that I am not some fifty years younger than I am, because then, I should have been able to derive some advantage from the paper, for I am afraid that I am now too old to learn. In my younger days, education was not so much thought of, and I may be somewhat in the situation of a certain "Claimant" of whom we have heard so much, and who did not know whether a regiment was in "close" or "open" order. I am very glad to see that those times are changed, and that meritorious young Officers are doing all in their power to make our profession one of the most practically well-instructed that can be found in the world. I believe that the strong, enthusiastic feeling, pervading all ranks of the Army at the present time, cannot be excelled in any nation of the globe.

Captain Tulloch: In the military annals of our country, it would be hard to find any period in which greater changes have been made in the organization and administration of the Army than during the last two or three years. The causes, which have brought about the changes in question have been so often discussed, and are so well known, that I shall merely touch on that which has reference to the education and professional training of young Officers. I venture to bring to your notice my views on the subject, in the hope that, however crude, they may, nevertheless, do something towards throwing additional light on a question of so much importance.

Up to the year 1849, Officers were appointed to commissions in the

cavalry and infantry by nomination. When a young gentleman desired to enter the Army, all that was required for placing him on what was known as the Commander-in-Chief's list was that his name should be forwarded by some general Officer as a voucher for his respectability; once on the list, the name of the embryo ensign or cornet, in due time, arrived at the top, and if then of the proper age, he was duly gazetted, either with or without purchase. In certain special cases, gentlemen were gazetted soon after their names were placed on the list, but the usual practice was to take every one in his turn.

In time of peace, the demand for Officers was comparatively limited, and by far the greater proportion entered the Army by purchase; commissions without purchase were, however, given by the Commander-in-Chief to the sons of old and deserving Officers and others who had done good service to the state. A certain number were also annually granted to Sandhurst cadets, who passed special qualifying examinations, and a few were given to deserving non-commissioned Officers.

In February, 1849, a circular was issued, informing all candidates for commissions that they would have to pass an educational examination before being gazetted. The test was by no means a difficult one; any schoolboy who had received a respectable education could have accomplished it. The publication of the circular, however, appears to have created a regular stampede amongst the candidates, many of whom at once removed their names from the Commander-in-Chief's list. The examinations, instituted in 1849, continued in force till 1857, with this exception, that during the time of the Crimean war their stringency was so very much relaxed, that practically the examinations were a mere matter of form, and for a short time during the Indian mutiny, when the supply of soldiers did not equal the demand, free commissions were granted to any one who raised a certain number of recruits.

About this period, viz., in April, 1857, the Council of Military Education was established, and with it commenced a new era in the educational requirements and professional training of Officers. The examinations, instituted in 1849, being considered very unsatisfactory tests of a candidate's general education, the Council were directed to revise the whole system of examination for direct appointments to the Army. The head masters of the principal public schools in the country were therefore consulted with the view of ascertaining the amount of knowledge which might fairly be expected from young men of 17, and on the statements of the schoolmasters a new scheme was established in 1858. Now although the examination in question was by no means severe, the Council were nevertheless obliged from time to time to diminish the difficulty of it, owing to the inability of so many of the candidates to come up to the standard which had been practically established by those who had instructed them.

As an illustration of the value put on certain subjects of instruction by the head masters of public schools in 1857, it may not be out of place to mention that in the examinations then established, a candidate might obtain 2,000 marks in Latin, 1,600 in Greek, but in English or French, 1,200 only. By 1867, the obligatory portion of the examination

for direct commissions had been made very much easier; in English, $\frac{1}{6}$ of full marks was sufficient to qualify in that subject, and although a candidate might obtain 10,800 marks, a total of 1,500 was all that was necessary for passing. Notwithstanding the apparent mildness of this test, hardly any boys, educated at the public schools, dared venture to attempt it without previous preparation by a crammer.

Now with reference to professional training. An Officer on joining his regiment was, as a matter of course, taught his drill, but any knowledge of his profession beyond that which could be obtained in the barrack square, he had little or no means of acquiring. The subalterns were generally assembled once a week in the ante-room for school, under one of the majors, but in nine cases out of ten the subject of instruction, if instruction it could be called, was confined to the bare routine of battalion drill. In this weekly school, even when instructing in ordinary drill, there always appeared to be a great want of system, a defect which was also very conspicuous in what were known as adjutant's parades. In some regiments, Commanding Officers used to detail the movements—usually restricted to three—which were to be performed under the adjutant, but in many cases he was allowed to execute any manœuvres he chose, the result being that from continually knocking about the battalion as he pleased, the most stupid adjutant in time got the reputation of being a good drill, but he alone of all those present on parade really profited by the performance. Another very impolitic measure by which drill was made distasteful to young Officers was the prevailing custom of requiring all Officers junior to the adjutant to attend his drills, thus the presence of an Officer at a parade, which was often looked on as a mere waste of time, depended not on his efficiency, but on the adjutant's place on the list of subalterns.

Before finally leaving the question of adjutants, it may not be out of place to notice what has occasionally been suggested, viz., that they should not be allowed to hold office as such in regiments for more than two or three years, so as to give as many of the best Officers as possible a knowledge of adjutant's work, such work being about the very best that could be devised for making a first-rate Officer.

But to return to the subject more immediately under discussion. In addition to school in the ante-room once a week, subalterns were by an order dated 19th January, 1859, required to send in a report and sketch of the country whenever the battalion was exercised in route marching. Those Officers who had been educated at Sandhurst usually made out readable sketches and reports, some being remarkably good, but the productions of those who had never received any instruction in delineating ground or in making a concise military report were, as might be expected, simply so much waste paper. Orders were complied with, certainly, but practically the whole affair, as far as the training of the uninstructed Officers was concerned, was useless.

Occasionally Commanding Officers, who knew from experience on active service how important it was that every Officer should be instructed in outpost work, did their best to give both Officers and men some training in that duty; the opportunities for doing so, how-

ever, especially in this country, occurred but seldom, Commanding Officers being strictly prohibited from trespassing on private property.

As regards examinations for promotion, they were first instituted in 1850. Ensigns, before being recommended as fit for advancement in rank, were required to show that they were acquainted with their drill, regimental duties, Mutiny Act, and Articles of War. Lieutenants before promotion were informed that, in addition to the examination in drill, &c., they would also be required to pass an educational test, which must have made the gray hairs of many an ancient subaltern stand on end with astonishment, the subjects in which Officers in question were to be examined being as follows:—History, ancient and modern; first six books of Euclid; properties of the circle; algebra, to quadratic equations, inclusive; logarithms; plane trigonometry and mensuration; permanent and field fortification; military law, &c. As a matter of course such a terrible ordeal was rarely, if ever, enforced.

In 1858, the regulations with reference to promotion were revised, the examinations being made entirely professional, and confined to those subjects which a regimental Officer ought to know. With some slight revisions, these tests as ordered in 1858 continued in force until 1870, the only real difficulty in the examinations being that which related to field fortification, reconnaissance and outpost work. Having little or no opportunity of receiving instruction in such matters, Officers were obliged to get them up as best they could from books, those books, in which the different subjects were compressed as much as possible, and with the contents arranged in the form of question and answer, being the favourites. The great drawback, however, to such a method of getting up a subject, about which the candidate really knew nothing, was that occasionally question and answer did not fit. At one examination which I happen to remember, an Officer described a gabion as a fortification made of sand bags, &c., whilst another said it was a redan with flanks.

In 1870, commenced the first of a series of the most important changes with regard to the first appointment and training of Officers which had taken place for many years. The Military College at Sandhurst, after having educated cadets for nearly three-quarters of a century, ceased to do so any longer, and in the year following the old method of appointing Officers by nomination and purchase was abolished, the time-honoured rank of Ensign or Cornet being replaced by a new designation—Sub-Lieutenant—the status of which, by the way, does not appear to be clearly defined,—and the Army was in future to be supplied with Officers by assigning a proportion of the vacant appointments for public competition, and by giving each Militia regiment of a certain strength the nomination of one Lieutenant's commission annually, the remaining vacancies being filled by candidates from the universities, Queen's Cadets, and deserving non-commissioned Officers.

The new grade of Sub-Lieutenant differed from that of Ensign in that the appointment was only probationary. Sub-Lieutenants were

to serve about a year with their regiments, where they were to learn their drill, interior economy of battalion work, and such like; if then favourably reported on, they were to be sent to the Military Collge at Sandhurst for instruction in surveying, fortification, &c. The Sandhurst examination successfully passed, the Sub-Lieutenant was then gazetted as a *bonâ fide* commissioned Officer, with certain antedates.

Considerable changes were at the same time also made in the examinations for promotion after entering the service. A knowledge of field fortification, military surveying, elementary tactics, and military law being now required (in addition to the former subjects), a special examination in the branches just named was then instituted; and in order to give Officers opportunities for acquiring such professional knowledge, Garrison Instructors were appointed at all the principal stations at home and abroad. Being the first Officer nominated to fill one of these appointments, it is to the working of the new system and the deductions derived from nearly three years' practical experience of an Instructor's work that I now more particularly desire to direct your attention.

The Garrison Instructor being an entirely new species, was at first looked on with rather a suspicious eye by the younger Officers, who seemed to think that they might suddenly be seized by him as by a bird of prey, and carried off for immediate instruction; the first result of my arrival amongst them was a general rush to pass the examination for promotion under the old rules, in order that they might thereby save themselves from falling into my clutches.

The professional, not to say prophetic, knowledge attributed to the Instructor was at times quite startling. One Officer of some standing gravely asked me just before the outbreak of the French war to give a lecture on the subject, and inform them what was going to happen.

The departments also were occasionally rather at sea about the new appointment, and I am afraid that I must have given them a good deal of trouble with my strange requisitions; nevertheless they were none the less willing to do everything in their power to help me.

The young Officers finding at last that the Garrison Instructor was a very mild, inoffensive individual, and by no means likely to suddenly explode in their midst, and annihilate them with fragments of learning, became less suspicious, and eventually I commenced my first course with a class composed of four Officers, who must have made a favourable report of what had happened to them, for afterwards I rarely had less than a quarter of the Captains and subalterns in the garrison under instruction at a time, and with two exceptions only, more willing pupils it was impossible to wish for. The only decided obstacle I had to contend with was the very imperfect education which many of the Officers had received when boys at school. You will be rather startled to hear that I never yet had a class in which I was not obliged to teach some of the Officers composing it vulgar and decimal fractions, and I specially remember that a very simple rule of three sum was on one occasion too difficult a problem for any one in the room. Equations were things which many had apparently never heard of, and the Officer who could write a concise report, especially in a legible

hand, was, in some classes, rather a *rara avis*. As regards subjects of general information, I also found in two or three instances an astonishing deficiency of education. There passed through my hands representative pupils of many English schools, and from the information obtained from different Officers, I came to the conclusion that several of them had had their time almost entirely wasted at school, and that their only acquirement had been a smattering of Greek and Latin.

A classical education, when *completed*, will have disciplined the mind possibly quite as much as a mathematical one; but when a so-called classical education stops before it even gets to the threshold of completion, I cannot but think that so much time taken up in stringing together Latin verses and in wearily plodding through Virgil or Homer, almost to the exclusion of other subjects, is time misued.

I by no means wish it to be understood that all the Officers who attended the classes were badly educated, very far from it, some having taken their B.A. degree at college, but this I do mean to say, that fully one-fourth of them had received a very defective education indeed. How the schoolmasters that professed to have taught them could have been satisfied with their work I cannot understand. With two or three exceptions, there was no want of natural ability shown by those Officers who had been so badly educated; but unfortunately it took a very considerable portion of the four months during which the course lasted to get some of them into the habit of using their brains at all. At times, their intellects seemed suddenly to awaken as if startled from sleep; occasionally the process was more gradual, but as soon as this change had taken place and they began to think for themselves the great difficulty of instruction was overcome, and some of those who appeared very dense at the beginning of the course turned out remarkably well afterwards. Some few,—fortunately I had never more than two in any class,—were naturally so defective in intellectual power, or had received so little attention when at school,—I am strongly inclined to believe that the latter was the true state of the case,—that the labour of imparting instruction to them became almost a physical one. I have often, after only three hours' with the class, been quite as much exhausted as if I had been pulling a heavy oar all the time. Had it not been for the willingness, in fact I may say the intense desire on the part of the Officers referred to, to obtain professional information, it would hardly have been possible to have continued the uphill work of instructing them.

As regards the question of Officers being desirous of instruction, many people fancied that they would not care to return to what might appear rather like schoolboy work; that fear is now a thing of the past. Very young Officers who have just escaped from the thraldom of school do not, as a rule, take to book work so well as those who have been longer in the service; but I can safely say that it is the exception for an Officer of any standing not to be desirous of improving his professional knowledge by going through a course of garrison instruction. Of course there are men to be found in the Army, as in every other profession, who are so deficient in mental stamina that exertion of any kind, even for the most fascinating of field sports, is

distasteful to them. Fortunately such hard bargains are not numerous, and in some regiments do not exist; they of course are not to be found amongst the Garrison Instructor's voluntary attendants.

With reference to the support given to the system by Commanding Officers, all I say is that it would have been impossible to have wished for more. From the General commanding, downwards, everyone took the greatest interest in its success. As soon as the nature of the course was understood the Colonels of the different regiments offered to change parade and orderly-room hours, or do anything that I could suggest for the purpose of enabling as many Officers as possible to attend, they themselves being present when any out-door work was going on. With regard, however, to the facilities for continuous study without interruption from regimental work, I think there is room for improvement. A very excellent feeling prevails in most regiments, and especially in those where *esprit de corps* runs high, which makes Officers averse to being struck off duty and thereby throwing their work on others. Several Officers, in fact all the Captains, except one, who went through a course of instruction, declined to be struck off duty, they merely got leave from parade during the time the course lasted, and did their company work and the duty of orderly Officer of the week when I did not require them.

Captains and Subalterns had occasionally hard work to be in time for lecture after being present at orderly-room with their prisoners, &c. A conveyance of some kind was usually kept waiting just outside the orderly-room, and as soon as their work was done they came down at full speed to the class-room.

Sometimes much valuable time was lost from interruptions such as I have mentioned, which made me almost decide that unless Officers would consent to being struck off all duty, so that their attendance with the class might not be interfered with, I would not undertake to put them through a course of instruction; but on considering that the Commanding Officers had done everything that was in their power to enable as many Officers as possible to attend, I came to the conclusion that it was my duty, and the better policy, to leave matters as they were and do the best I could under existing circumstances. The willingness on the part of the Officers to attend, in spite of all obstacles, was indeed in itself a sufficient reason for overlooking such irregularities. Many a time have I admired their determination not to be a minute late for lecture, although the weather in winter was at times hardly faceable, with the thermometer 10° below zero and a breeze blowing that sent the *poudré* snow into the innermost recesses of one's wraps. Schoolmasters at home would be rather astonished at finding their pupils obliged to make their way to school on snow-shoes. At Halifax it was no uncommon thing for Officers to get frost-bitten on their way from barracks to the class-room.

At the request of a Commanding Officer, who justly considered that instructed non-commissioned Officers would be invaluable assistants to an Officer who had to put an outpost or position into a state of defence, I obtained authority for establishing a class for sergeants, none but the most intelligent being sent. The result was very satis-

factory. I was quite astonished at the aptitude many of them had for using a pencil. To enable them to attend regularly they were excused guards and parades, but nothing else; they had even to arrange for some one to do their orderly work. To give you an idea how they took to instruction, I may say that, amongst others, a sergeant-major of one of the smartest regiments in the service went through a complete course, and the only part of his regimental work from which he was excused was attendance at Commanding Officers' parade, and orderly-room afterwards, when possible. I am happy to say that he passed an excellent examination; his road, river, and outpost reports were certainly amongst the best I had ever read; they were clear, concise, and written in a very legible hand, which last is really no small recommendation.

The result of observations made on the working of the system of garrison instruction may, I think be summed up as follows:—

1. That a considerable percentage of Officers have had the elementary portion of their education so neglected that they are unable to benefit by instruction as much as they might otherwise do.

2. That Officers are, as a rule, very desirous of acquiring professional knowledge, such as is given in a course of garrison instruction, and that they will put themselves to any inconvenience imaginable to attend a course.

3. That owing to regimental duties of various kinds, social as well as professional, an Officer undergoing instruction, when with his regiment, is liable to a detrimental amount of interruption of work during the course.

4. That instruction in any but temperate climates is carried on under considerable disadvantages.

5. That many non-commissioned Officers are anxious for professional instruction, and that a considerable portion of those are well qualified to receive it.

To meet the different requirements indicated by the conclusions just mentioned, it would be necessary first of all to demand that the elementary education of candidates for commissions should be more attended to.

As regards Officers, it certainly seems that when undergoing instruction they would be better away from their regiments, and might receive instruction to greater advantage if sent to institutions analogous to those at Shoeburyness and Hythe.

With reference to non-commissioned Officers, a more elementary course might be arranged for them, the instruction being given by a duly qualified subaltern of the regiment to which they belonged.

Before going into the details connected with these proposed changes, it will be necessary to refer to the present method of supplying the Army with Officers. It has already been stated that vacant appointments are to be filled by Militia subalterns, candidates from the universities, Queen's Cadets, or by open competition, the three last-named classes receiving probationary appointments confirmable on their passing certain professional examinations, after about eight months' instruction at Sandhurst. Concerning the Militia candidates

and Queen's Cadets, who only require to pass a qualifying examination, I will now say but little, except that, in fixing the standard of the examination, care should be taken that no one be allowed to enter the service unless most thoroughly acquainted with elementary arithmetic, and also able to write an ordinary letter or report in clear concise language and in a legible hand. It is certainly impossible to appreciate too highly that peculiar training at public schools which develops those qualities so requisite in an Officer, viz., gentlemanly feeling and manner, and a love of amusements requiring physical strength and skill, but as regards book learning, I cannot help thinking that too much time is still sacrificed to Greek and Latin to the detriment of more useful accomplishments. Not one Officer in a hundred, perhaps not one in five times that number, ever opens a Greek or Latin book after entering the service. If in pursuit of some particular study, one requires to refer, for instance, to Pliny or Herodotus, an English translation at once supplies the information wanted, probably in much better form than any ordinary classical scholar could render it. Many an Officer who desires to improve his professional knowledge finds himself stopped almost at the very commencement of his efforts from inability to read French or German; frequently have I heard such men rail at the time wasted at school in learning the dead languages, of which they then hardly recollected a word.

Before quitting the subject of Militia candidates, I may suggest now that that force and the Line are to be united, the more closely they can be drawn together the better. It is to the Militia that I think we must look in time of war for the reserve supply of young Officers, without which, reserves of men are of comparatively little value. Militia subalterns might be encouraged to go through a Sub-Lieutenant's course on the understanding that all vacancies which occurred in the Line battalions of their brigade, when on active service, should be filled by Lieutenants who had so qualified, provided that at the time of appointment they were not too old—say not more than 24 years of age. With such inducement, it might even be possible to obtain supernumerary subalterns for the Militia. I may here observe that those Army reformers who so persistently state that the Army is over-officered can have but little idea how rapidly regimental Officers are used up. As soon as the organization of a force for field service commences, staff, train, field depôts, and in fact every department without exception in one way or other demands Officers from the Line, the result being that a regiment which actually takes the field with two Officers per company is rather lucky than otherwise. On one occasion, when performing the duties of adjutant, the inadequate number of Officers in my regiment was particularly brought home to me. At the time in question we were engaged in what proved to be rather a short campaign; but one Officer had died, and only two had been sent away sick; nevertheless the departments had absorbed so many Officers, that on the regiment parading, for what might have been a heavy day's work, there remained but one Officer per company, and two for the colours. I remember being rather puzzled as to whether, in the event of any casualties happening amongst the Captains or subalterns, I

should be afterwards justified in allowing the colours to be carried by sergeants, in order that every Company might, if possible, be commanded by an Officer.

But to return to our more immediate subject—the present entrance examinations. With reference to the system of open competition, which is such a favourite with some people in this country, all I can venture to say is that many persons, who are no mean judges of the question, are much opposed to it, and that in the Army especially, where certain requirements of character are of far greater value than much learning, competition is out of place. The old method of nomination certainly possessed one very decided advantage over the present regulations, inasmuch as that no person could get his name placed on the Commander-in-Chief's list without a guarantee, from some Officer of high standing, that he was a fit and proper person to hold Her Majesty's commission. In time of war, when there was a great demand for Officers and no reserve to fall back on, it was not always possible to adhere to this rule; the pernicious effects consequent on its infringement are well known to every Officer who was in the service seventeen or eighteen years ago, and ought to be a warning that something more is necessary than a mere certificate of moral character from a parish minister or schoolmaster. But putting that question aside, the competitive examination is subject to a drawback which is common to all such methods of testing the qualifications of candidates, the defect being that such examinations encourage, in fact almost oblige, those who wish to give themselves every chance of success to have recourse to teachers who make it a special business to prepare candidates. Cramming, as the process is popularly termed, does undoubtedly pay, no matter what examiners may do to discourage it.

The fees demanded by crammers are very heavy (but certainly not more than they deserve for their work), and it is not every one who can afford to pay them; consequently those candidates who are not well off, the sons of old Officers, for instance, will be very heavily handicapped in this new competition struggle.

With a view to induce some one, better qualified than I am, to arrange some scheme for placing the sons of Officers on an equality with their richer neighbours, I think I cannot do better than direct attention to the circumstance that the Military College at Sandhurst was originally established in a great measure for the education of the sons of Officers partially at the expense of the public. At the abolition of the Cadet College in 1870, the amount annually granted by Parliament was about £20,000. Officers have now ceased to derive any benefit from an establishment which was a great boon to the Army for many years. The establishment of a school for the education of the sons of Officers, is too much to hope for, and might not be advisable: perhaps, however, as the Sandhurst grant, by which Officers benefited considerably, has come to an end, an annual sum might be voted for Army scholarships in the different public schools of the country which give, what is called, a modern education.

While on this topic, one educational institution should not be forgotten, viz., Wellington College, which was established as a memorial

of the great Duke, and for the education of the orphan sons of Officers. About £159,000 was subscribed by the Army and the public, and £25,000 was added from the Patriotic Fund, in return for which about 80 boys are maintained and educated on the foundation, at little or no expense to their friends. Eighty foundationers certainly seem rather a small return for £184,000, but the matter is, perhaps, to a certain extent, made up to the Army, in that the sons of Officers are educated at the College for £30 a year less than the sons of civilians, who are permitted to participate in the benefits of the Institution. The advantageous position occupied by the sons of Officers is, however, somewhat theoretical, as their education, even at the reduced rate, costs £110 per annum. Why education at Wellington College should be so much dearer than at the popular and most successful proprietary college at Cheltenham, it is difficult to understand.

Now that Wellington College—which in a certain sense belongs to the Army—is regularly established as one of the educational institutions of the country, might it not be enlarged at a comparatively slight expense, as regards original cost for building, so as to take in a much greater number of boys, sons of Officers in the Army and Navy? The construction of eight or ten additional class-rooms and boarding-houses and the salaries of a similar number of tutors and assistant-masters would not be much to ask for, in part compensation for the abolished Sandhurst grant. With instruction provided at the public cost, £55 a year, or rather for nine months (three months being absorbed by the holidays), should be ample for a boy's board and all other expenses (clothing and pocket-money excepted), provided the boarding-houses were properly supervised, and all unnecessary expense and extravagant habits prohibited.

Having pointed out what appears to be the weak points of the new system of entrance examination, I will now pass on to technical instruction, considered necessary after joining the Army. With reference to the professional education of Officers, I think that one of the principal disadvantages attending the present system of garrison instruction, viz., interruption of work, might be got rid of by amalgamating the establishment at Sandhurst and the classes of the garrison instructors in this country, forming therefrom two or three large schools for professional instruction—two for England and Scotland and one for Ireland. The College at Sandhurst already exists, the establishment of the remaining two need not be very expensive. A few class-rooms, a lecture-hall large enough to accommodate 100 people, a modelling-shed, and four or five acres of practice-ground, would be alone necessary. Of course, quarters would be required for the Officers and Sub-Lieutenants attending the school. The country in the vicinity should be open and undulating; if a river happened to be near, so much the better.

By combining the instruction of older Officers with that of Sub-Lieutenants, a steadying element would be introduced, a want which appears to have been lately felt at Sandhurst. In suggesting these schools, where I consider a course might be thoroughly completed in four months, I start with the assumption that only those professional subjects which are indispensable to a regimental Officer, and which he

cannot acquire elsewhere, should be taught, viz., field fortification, military surveying, elementary tactics, and military law.

Everything else which a subaltern must be acquainted with, such as drill and interior economy, should be imparted to the Sub-Lieutenant when with the home regiment of the brigade, instruction in those matters being under the superintendence of the Major of the battalion.

I also assume that every Officer is capable of undergoing 30 hours of study or out-door work in a week—six hours a day and a holiday on Saturday. Cadets at Sandhurst had 33 hours' work per week. In seventeen weeks there will, consequently, be 510 hours in which to go through the entire course. The time to be divided as follows:—

Fortification lectures, one hour each	25	hours
Elementary tactics, including outpost and advance guard work, &c., lectures one hour each..................	20	,,
Outlines of strategy, just sufficient to show the meaning and necessity of a base of operations, line of communication, and such like, lectures of one hour each......	5	,,
Military drawing, 20 lessons of two hours each........	40	,,
Fortification drawing, 15 lessons of two hours each	30	,,
Military law, lectures of one hour each	12	,,
Total.........................	132	,,

Thereby leaving, for the practical outdoor work connected with sketching and fortification, 378 hours. That 510 hours are fully sufficient for the course proposed, will, I think, be allowed, when I state that a course of garrison instruction has to be completed in 255 hours.

By concentrating the instruction in two or three large schools, there would be this special advantage with regard to the instructors, viz., that each might confine himself to that one subject for which he had a speciality. The supply of large models, material, and labour might, practically, be unlimited, all of which would greatly facilitate the work of the instructors.

Now to get over the difficulty about senior Officers objecting to being struck off duty. At present four subalterns per regiment are not unfrequently off the regimental roster, for the purpose of attending the course, with as little interruption as possible. Instead of four subalterns per battalion, limit the total number of Officers allowed to attend to four, including Captains; and subsequently, as soon as promoted, and consequently instructed, Sub-Lieutenants begin to join the battalion, reduce the number of Officers allowed to leave the regiments for the purpose of attending the schools to three, and afterwards to two. A regiment could stand having two duty Officers away at a time undergoing instruction, more especially if Officers on the staff were seconded, as they certainly ought to be. Sub-Lieutenants being merely with the battalion to learn their drill and regimental work, could not as a matter of course be included in the list of duty Officers.

As regards regimental instruction for non-commissioned Officers, it has been suggested that the Musketry Instructor might undertake it,

but that would not be possible, for this reason, that during the summer, when the out-door practical part of the work would be going on, the Musketry Instructor has his time very fully occupied with the annual course of rifle training. If any attempt be made to put non-commissioned Officers through an elementary course, and to teach the men how to handle a spade or pick when close together, on a working party, to make gabions, and so on, a regular instructor should be appointed for the purpose; he might be selected from those subalterns in the regiment who had been through a school of instruction. If the instructor's work did not exceed three hours a day, he might, in addition, be required to superintend the management of the canteen, recreation room, regimental workshops, &c. The present canteen system is one of the greatest benefits conferred on the *private* soldier for some time past, but many Officers dislike exceedingly being obliged, whether they will or no, to attend to work which is anything but professional; neither do they like having thrust upon them the responsibility and anxiety consequent upon keeping a large grocery store and beer-house, in doing which they may unavoidably lose, and many have lost, considerable sums of money. Were the duty in question part of a paid regimental instructor's work, one great drawback to the canteen system would be got over.

Before taking leave of the question of instruction, it may be as well to suggest how Officers are to keep up what they may learn at the schools, and also how they are further to improve their professional knowledge. I think a suitable plan for so doing may be arranged by taking a hint from both the Prussians and the Americans.

Instead of confining ourselves to marching out reports, and sketches, why, when so many Officers are qualified to do so, should we not adopt the Prussian plan to a certain extent, and let the Officers of each company in turn practise, say twice a year, those duties which they would be called upon to perform on service, such as strengthening an outpost, arranging a plan of attack or defence adapted to a particular piece of ground, and so on? Officers would take the greatest possible interest in such work, and the Colonels of regiments would have a better opportunity of ascertaining the capabilities of their young Officers than they have at present. The plans and reports to be laid before the General at inspection, with the companies' books, each Officer being called up in turn to answer any question, concerning his plans, which the General may ask.

Now with regard to the American idea. In that country, where people are so desirous of information on every possible subject, public lecturers travel from city to city. Might we not institute something of the same kind for the benefit of those Officers who wish for advanced instruction in strategy and tactics, such as is given at the Staff College. Officers who are recognized authorities on such subjects, and who are at the same time really good lecturers, are few in number, but as three lecturers would probably be sufficient for the purpose suggested, that number ought to be obtainable if the appointments were well paid. The lecturers might take the large garrisons in their districts in rotation, giving a course of, say five or six lectures on each visit.

In conclusion, I venture to hope that I may never again hear that senseless cry, raised by men who know nothing of the service, that young Officers are a careless, happy-go-lucky lot, who think only of amusement. In no profession will you find men so anxious for professional information, in none will you find men so willing to go through difficulties to obtain it; but give them the opportunity of learning their work, and they will show themselves to be as superior to continental Officers in the more elaborate training required for warfare in the present time, as they were in those glorious days of old, when the simple English line proved superior to all other formations for attack or defence. Some young Officers, by reason of the defective education which they received when at school, are unable to benefit by instruction as much as they might otherwise do. If my lecture has any effect in directing attention to the subject in question, it will not have been given in vain.

The CHAIRMAN: The subjects for discussion are as follow:—

1. Ought any alteration to be made in the present qualifying Examination for Commissions, for the purpose of inducing the masters of schools to pay more attention to instruction in Arithmetic and English Composition?

2. Would it be advisable to establish two or three schools, analogous to Hythe or Shoeburyness, for the instruction of Officers, in place of the present system of Garrison Instruction?

3. Ought Non-commissioned Officers to go through a short practical course of Field Fortification, to enable them to act as assistants to their Officers? Would it be advisable to have a Regimental Subaltern Instructor to teach the Non-commissioned Officers; the Instructor in question to superintend the canteen, regimental workshops, &c.?

4. Would it be possible to obtain the services of two or three good lecturers on Strategy and Tactics who would give regular series of lectures (similar to those given at the Staff College) at certain large military stations in the United Kingdom?

5. The Sandhurst grant, by means of which Officers' sons were cheaply educated, having come to an end, might it not be renewed in the form of Army Scholarships?

6. Would it be feasible to enlarge Wellington College for the benefit of the Army and Navy?

7. Would it be possible to form a Reserve of Subalterns for the Line, who should serve with the Militia in time of peace?

Sir THOMAS DYKE ACLAND, Bart., M.P.: If the first question be passed over as admitting of no controversy, I, though only a civilian, may take the liberty of saying two or three words. I think we are very greatly indebted to the gallant lecturer for the strong stand he has made in favour of education, both unprofessional and professional; and still more must those of us who are connected with Officers in the Army, feel grateful to him for that testimony which he has borne, and which many civilians might also in their humble way bear, to the zeal for knowledge which, I believe, for a long time past, has pervaded the Army. The difficulty in which young Officers were placed in former years was, first of all, that their time was so wasted upon routine duties, if I may presume to say "wasted," that a man never knew what time he had for study; he was always liable to be called out on the most ordinary matters of routine, and placed in a position most unfavourable to study. And, in the next place, I am rather mistaken if a young man sometimes was not liable to be called to account for intending to be a General before he was a Captain; and so young men were sometimes driven into a corner, and almost pretended to think study was useless when in their hearts they really would have been very glad to have been encouraged to study. With regard to the first point, I must, apparently at least, differ a little from the lecturer. It may be my public school prejudices, but I am rather mistaken if the opinion of Commanding Officers generally would not be very favourable to the qualities of an Officer in the

Army who, perhaps, having no experience of military command, might be sent on board ship with a draught or body of men under his command, if he had happened to be captain of the boats at Eton. I have heard the remark made, that young fellows fresh apparently from London society, and an assumed life of great idleness, have shown extraordinary qualities of command, which could only be accounted for by their public school training. I must differ from the lecturer when he seems to say that a man learns at a public school only gentlemanly manners and fondness for amusement. I am quite alive to the idleness of public schools. I have perhaps had some share in it myself, and I have seen a good deal of it in some of my young friends who I should like to see a little more diligent. But I think that boys do learn a great deal at public schools unconsciously; and if you are to lay down the principal that a young Officer does not want Greek and Latin afterwards, because he can read from a crib if he wants to know what Herodotus or Polybius may have said on military matters, no doubt he may do so; but that is not education, boys do not learn Greek and Latin at school, in order to be able to hunt up some passage from a Greek or Latin classic. They learn Greek and Latin in order that they may get not only a gentleman's education or a merchant's education, but that they may learn what human beings are and how to command their fellow-creatures, and how to obey those who are set over them. Classical literature, if of any use at all, is so, because it is human and because it calls out that in man which is of most importance for him to know, especially if he is placed in command over other people. Captain Tulloch has suggested that more attention be given to English composition. I never was taught English Grammar when at school, and I have had to work very hard at English composition in a particular line of occupation which fell to me as a matter of duty, for I had to learn English after I was forty years old. I very much doubt, however, whether learning English Grammar at school would have taught me half as much as learning Latin Grammar did. I doubt also whether if you are to say that boys, because they are to go to the Army, should not learn Greek and Latin, but should learn French and German, you would mend the matter very much. However, I am perhaps getting too much into the question of what is a sound English education. Let us turn to experience—what is the great strength of the Prussian Army? First of all, the Officer of the Prussian Army is essentially a born gentleman; secondly, he is not only a born gentleman, but he is a generally educated gentleman. He must go through an unprofessional, classical, and mathematical education, if I am not greatly mistaken. I am not sure how far certain military schools are really general. I may be mistaken about the Officer, but I am pretty certain I am not mistaken about a large number of the Non-commissioned Officers. The "Einjährige"—one-year man—is essentially an educated man. He goes into the ranks to serve for one year, and he gets that privilege, not merely because he has money enough in his pocket to pay for his outfit, but because he has been at a gymnasium or a Realschule, and has had a good general education, and he must absolutely have proved, by examination, that he has had a thorough and general education. These men, if I am not mistaken, are the life and soul of the Prussian Army—a link between the private and the educated gentleman, who is the Officer. They become Non-commissioned Officers in the Army, and afterwards Officers of the Landwehr. If that is a fact, it is a strong testimony in favour of a general education. I hope I have not spoken too eagerly; but I beg to hail, with thanks also, another sentiment from the lecturer, which is, that some kind of inducement in the nature of scholarships should be held out to our schools generally. I have had a great deal to do with the middle schools of England; and, I am sure, nothing has done more good in England than giving an open career to all our public schools, grammar schools, middle schools, private and public, and bringing them all to the test of university examinations. I believe that the more you have free trade in education in England—if you only keep up attention to the social position and gentlemanly feeling which pervades educated men generally, even although they may not have been very highly born to begin with—the more freedom you give, the better preparation will you give to a man, either for a position of an Officer in the Army, or any other position in which he may eventually be placed.

Major KNOLLYS: As Garrison Instructor, my Lord, I have naturally had my

attention very much turned to the subject on which we have heard so able a lecture to-night. It is impossible to overrate the importance of the present step in the direction of increased attention to Military knowledge. Previously to the Crimean war, the state of Military education was at its lowest ebb. It is easy to account for that fact. Until General M'Dougall, about 1855 or 1856, brought out his work upon the Art of War, there was scarcely a book in the English language that treated of that subject. There were one or two, but they were very little known; and these did not deal with the subjects of strategy and tactics as a whole. Another very great reason for it was an entire misapprehension of the practice and ideas of some of the most celebrated warriors of modern times. The Duke of Wellington has often been quoted as a man thoroughly practical, who achieved his great successes by dint of hard common sense, aided by a natural talent for war, and considerable experience. It may not be generally known that the Duke of Wellington never passed a day without devoting some portion of it to reading. Then take Napoleon. There never was a man in this world who had a greater natural talent and genius for war than he had, and yet no man studied more assiduously whenever he had leisure than did Napoleon. From an ignorance of these facts, and from the long time that we had been at peace, Military education had sunk, I say, to a very low ebb, and was almost despised. Military discussion on professional subjects was eschewed. Anybody who attempted it would have been put down as a prig at once, and it would have been said he was guilty of "talking shop." I remember myself, 20 years ago, coming from country quarters to a lecture at this Institution, and I recollect being called "a "young fool" for my pains. It made a very great impression upon me as marking the state of feeling in those days. Now, the importance of study is fully recognised, and the only difficulty is to indicate the best means of acquiring the best sort of study in the best possible manner. Still, even with this great appetite for knowledge, which we see all round us, and which I thoroughly believe to exist, the remains of the customs of the dark ages are barely now passing out of sight. I remember, a year or two ago, a certain Officer who, for a short time, attended some of my lectures, though he did not *attend* to many, for he was generally asleep, underwent an examination under the old rules, and being asked what a "gabion" was, said he thought it was "a sort of field work." He was asked to describe field fortification, and he said his idea was that it was "a field surrounded by forts."

With regard to the first point in the programme for discussion, I must say I have felt, as Captain Tulloch says, under very great difficulties in conducting instruction in my class, owing to the want, on the part of a large number of those who have been at the public schools, notably at Eton and Harrow, of even an elementary knowledge of geometry. In some cases I had to explain what an "angle" was, a "radius," and a "circumference." There was an amount of ignorance manifested that I hardly could have believed, had I not actually come across it in practice. That, of course, took up a great deal of my time to remedy. I had to do the work of a national schoolmaster, instead of fulfilling the higher functions—as I venture to believe them—of a Garrison Instructor. Besides that, I found that from want of study and mathematical instruction, their mental faculties were not trained to the acquisition of knowledge. These men were slower in acquiring new facts than those men who had received that admirable training which mathematics gives more than anything else in the world. With regard to classics, I have not had the advantage of being at Eton or Harrow, neither have I had the benefit of a regular classical education; but though I thoroughly recognize the advantage of the latter, I must say that it should be looked upon as an accomplishment rather than as a necessity. It is extremely desirable if you have time for it; but we should put everything in its proper place according to its relative importance. In these days of struggle for life and advancement, French and German are more important. After you have learned these things, then, by all means, go to your classics—polish your style. As to the immense use it is with regard to writing the English language, I would say, in reply to the gentleman who has just spoken, that I never was taught English Grammar in my life, and if I had not learned the Latin Grammar, I do not know where I should have been. I must say, however, that was certainly rather an indirect way of learning to speak my own language, and I am very sorry that I was not taught English Grammar. I may also mention with regard to obtaining historical information from the classics by

means of a crib, that Napoleon did so habitually. He carried a carriage-full of cribs about with him in all his journeys.

With reference to the second point, as to whether it would be advisable to establish two or three schools analogous to Hythe or Shoeburyness for the instruction of Officers, in place of the present system of garrison instruction, I do not quite see the necessity for it. Sandhurst is taking all the minor elementary work of the Garrison Instructors, and the functions of the Garrison Instructor should be confined chiefly to giving incidental lectures—to taking the senior Officers and lecturing them on strategy and tactics. Moreover, I myself am very strongly impressed with the importance of imparting education to young Officers regimentally, instead of either at Sandhurst or in courses of garrison instruction. I think you cannot overrate the importance of carrying on the instruction in drill, and what you may call the social military education of the young Officer at the same time with his technical education, and further, when an Officer is being instructed in his regiment, he knows that it is essential for him, if he wishes to be successful in life, to gain the good opinion of those about him, whereas, at Sandhurst, within certain limits, the good or bad opinion of the superior Officers has very little effect on his standing and position in the estimation of his own regiment. There is another objection to Sandhurst, viz., that there you have a number of young fellows brought together. The tendency of young men is to fall into thoughtlessness and irregularities, and they naturally encourage each other; whereas, in a regiment, the one or two young fellows would be completely leavened by the older hands, who would keep them in the proper groove. The strongest of all objections to Sandhurst is this: that after a young fellow leaves school and spends a year in comparative freedom and independence in regimental life, it is not reasonable to expect him to submit again to the necessary restraint attendant on such a course of academical instruction as is proposed. It is as reasonable to expect a tiger-cub, after tasting blood, to return to bread and milk.

With regard to the third question, I think it is extremely important that there should be a regularly trained non-commissioned Officer in each regiment to take charge of the working parties or to assist the Officer in charge of these working parties. I cannot see any possible difficulties in the way of this; it would be only necessary to send him to Chatham, or some other place, where there is a company of Engineers, and the expense would be only the cost of the railway journey. I agree with Captain Tulloch in what he said about the non-commissioned Officers, for, of all those that I have had to teach, I think the most eager in listening to lectures, and the most anxious to gather instruction, have been non-commissioned Officers and Officers of the auxiliary forces. They are men of a certain age—at least they have got over all the freshness and rawness of youth; whereas the men that I have had to deal with in my regular classes are young, and, though they are intelligent and very fine fellows, and men who, years hence, will thoroughly appreciate the advantage of learning, you could hardly expect them to be very keen to return to their books after such an extremely short holiday as they have had. As to the capacity of non-commissioned Officers for profiting by instruction, I must say it is of a very considerable amount. I have seen and read some most admirable sketches and reports prepared by non-commissioned Officers. With regard to the subaltern instructor, I am in favour of having instruction given altogether regimentally by one Officer appointed as the instructor of a regiment, and I think that one Officer would be able to undertake the instruction of the Officers of his regiment, and the non-commissioned Officers as well. I do not think, therefore, that a subaltern instructor would be particularly required, though there are plenty of men who are quite fit to fill that office.

Then as to No. 4. The possibility of obtaining the services of two or three good lecturers on strategy and tactics to give lectures at different military stations, is only a question of making it worth their while, and I am sure that plenty of good men will come forward.

As to the Sandhurst grant. This having come to an end, Captain Tulloch suggests that it might be renewed in the form of Army Scholarships. He says the Government grant at Sandhurst was £20,000 when it ceased, but that was only of late years. Formerly, Sandhurst was entirely self-supporting, and did not take one farthing from the Government. If any money appeared to be voted, it

was only a matter of account. I think it would be very desirable to induce the Government to sanction scholarships for Officers' sons; but I am rather doubtful of success. I must say it has often been a matter of astonishment and regret to me, seeing that, in the Army, there have been many men of large fortune, they have not themselves endowed scholarships. I am sure it is from no want of generosity on their part, but simply because they have not thought of it. I have a suggestion to make which might be received more favourably than Captain Tulloch's proposal, namely, that it might not be a bad thing to give a few of the most earnest students in the Army some sort of exhibition allowance to last for a certain time, so that the men might go to foreign countries and make themselves thoroughly acquainted with the geography and resources of those countries, sending home periodical reports of the results of their observations. I have been long impressed with the desirability of devoting more attention to military geography than has been hitherto paid in this country. The Government do not seem to have felt that, and they have voted so very small an amount of money for the purpose, that it is impossible for the able Officers entrusted with the work to accomplish one-tenth of what they know to be necessary. We have often found, on going to war that there has been the greatest difficulty in getting interpreters and guides and people to give information as to the resources, the exchanges and so on of other countries; and we have been obliged to go into the high-ways and bye-ways to pick up men very ill informed, of no reputation, and possibly in the pay of the enemy. If some encouragement were given to the study of military geography, there would not be a country in the world with which we should not be thoroughly acquainted, and when the information was required, all that would be necessary would be to lay one's hand on the pigeon-hole and pull out the documents giving the information required. I do not see any particular advantage in enlarging Wellington College any more than any other college. The education given at that college is thoroughly general; in fact, I know it has been the great object of the late head-master to make it as little military as possible. There is nothing military about it, except the names of the passages—Wellington passage, Murray passage, Pakenham passage—that is the only thing military about the place. And, in fact, they seem rather to object to the boys seeing very much of their military neighbours at Sandhurst. I know that, in Prussia, the tendency has been for some years to make education more and more general before entering the Army and more special afterwards, and I think myself that special education before a young man enters the Army can only be theoretical, and can be but imperfectly mastered.

Then, as to the last point. I read only a few days ago a most able work giving an admirable scheme of military organization, &c., in which the author treads upon everybody's toes, and upsets everybody's interests. The scheme he lays down is, in my opinion, an extremely able one. It provides a solution for what is, after all, the greatest problem of the day, that is, the extension of our Army by giving provisional commissions to Officers of the Volunteers—not the Militia, because, according to his scheme, the Militia would be available for services in any part of the world in case of war—but for giving provisional commissions to the Officers of Volunteers to be held by them for seven years: this commission to be made permanent on war, and the holders being recognized Officers of the regiment as if they had entered in the ordinary way. With regard to the general question of military education, the great point, after all, is to make it worth the while of Officers to study. I have heard Officers say over and over again, "What is the use "of my studying? I am sometimes very much bored; I don't know what to do; "time hangs heavily on my hands; what shall I do?" I have recommended them to take up some branch of study, such as military art, and they replied, "What is "the use? I may be ever so good an Officer; but a subaltern never gets any "advantage from studying his profession." We might go a little further and say that Captains and Majors do not get any benefit from studying their profession. The great point, therefore, is to make it worth the while of Officers to study; and this is not to be done by giving certain prizes as the reward of mere theoretical competition, which only shows that a man has a certain number of undigested facts in his head, which he has not been able to assimilate, and which he could not apply.

The real practical stimulus would be to give professional advantage to those Officers who show that they know how to apply practically their military knowledge.

Captain E. Rogers, Staff Officer of Pensioners, Longford: I rise with considerable diffidence to address this audience after the very able remarks by previous speakers on the excellent and truly suggestive lecture by Captain Tulloch. Certainly the instruction of Officers in the olden time was mythical, but who was to blame for it more than themselves? In my own regiment, the Colonel instituted a system of instruction by giving the details of the movements to be performed by the regiment on the following day, and also an intelligible critique on the performances of Officers and men the day before; and yet this book was irreverently called "the wanderings of an enthusiast." As regards the question of adjutants, I think that to add to the weight of their authority and responsibility they ought to be selected from among the captains, or at all events every captain and every subaltern of each regiment should be obliged to perform alternately the parade duties of adjutant, so as to get them thoroughly instructed in this portion of the departmental duties. Now, as regards Wellington College, I believe it partakes more of the character of an university than of a military academy. I do not know whether it is the case or not, but I should like to be informed whether this was originally intended by the charter when the College was first erected. There are surely educational establishments sufficient throughout the country without trenching on what ought to be our Army preserves. The sons of civilians who are educated at the College occupy the space and partake of the advantages which are due to the sons of retired Officers or Officers on half-pay. This evening, I had a conversation with an Officer whose nephew was educated at Wellington College, and on visiting it, he took very grave exception to the extravagance and luxurious style of the College in many ways. For instance, the boys provide their own furniture for their rooms, and where one boy could afford to furnish his rooms in an expensive manner, another could not do so, thereby raising and fostering a most invidious distinction very detrimental to discipline. This ought not to be. The days of military ignorance have, as your Lordship mentioned at the beginning, passed by, and every Officer, worthy of the name, is most anxious to be instructed in military matters, and to take advantage of that royal road to military learning afforded by the admirable institution of Garrison Instructors. I feel confident that if Captain Tulloch's suggestion be acted upon as to the appointment of special peripatetic professors, many will avail themselves of it in garrisons, hitherto shut out from the pale of military instruction, on the thousand and one questions of the hour, in which we are all so interested, and in which no country in the world should be so impressed as to their importance as our own. I have made only general remarks and have not gone through the questions *seriatim*, but I should like to know more about Wellington College from Captain Tulloch.

Sir Thomas Acland: May I be allowed to put a question? I was not aware that we were at liberty to travel over the whole field of questions. I wish to allude to one of them. I did not mean to set up any very great exclusive merit for a classical education as against mathematical, far from it. I think one of the great faults of Eton has been, not that they do not teach mathematics, but that they do not make the boys learn. The drift of my remarks was that something like what they have in Prussia, is wanted, namely, that a boy shall not be taken to have had a public school education unless he is submitted to some kind of test when he leaves school, and that ought to include mathematics, possibly some physical science; but I still think a little Latin grammar, properly learnt, would be an advantage. It is the idleness of the boys, not the want of good teaching, that is in fault. I would not advocate classics; as an Englishman, I think the shortest way to learn your own language is to learn a little grammar, well and thoroughly. One word about the non-commissioned Officers. I am a Volunteer Officer, and have worked pretty hard both in the Yeomanry and Volunteer Services for many years. I think I have gone through all the elementary work and the practical part of teaching as far as we civilians can learn it. One great want is to get non-commissioned Officers who know how to teach. For myself, I have a

perfect model of a non-commissioned Officer as a man of character, therefore I do not speak as a burnt child, but still we want to establish a normal school for non-commissioned Officers and drill instructors generally. It is all very well for a man to know his business by heart, but if he does not know how to teach it, I should very much doubt his being a good adjutant or a good regimental sergeant-major. But that is not my business. I am, however, perfectly certain that he would make a good drill instructor of us Volunteers, because we have only at most about 24 hours in the year to learn drill, and the great art of teaching the auxiliary forces is to teach them in a short time. I need not appeal to those who know what drill instructors generally are, to say that they waste a great deal of time. I should be glad if this Institution would take up the subject and impress upon the Commander-in-Chief, that non-commissioned Officers must not only be taught and know their education by heart, but they must be instructed how to teach. Schoolmasters are not allowed to go into elementary schools unless they are trained to teach; it is not enough for them to know the globe or the catechism, but they must be able to impart their knowledge. I speak on this subject with some practical experience, and I hope the Army will take it up.

Lieutenant Maurice, R.A., Instructor in Tactics, Royal Military College, Sandhurst: Speaking as one of the Officers engaged in the instruction at Sandhurst, I cannot venture to reply to Major Knollys' remarks, first, because I think it is absolutely essential in a discussion of this kind that one should confine one's self to the subjects strictly put before us, and secondly and chiefly, for the following reason:—Major Knollys' speech is a direct attack upon Sandhurst. Well, my Lord, with reference to that, our mouths are closed. The thing of all others which personally I am quite certain everybody engaged in the duties of the place would have wished, would have been that thorough public inquiry should have been made into the whole of the circumstances connected with Sandhurst. That inquiry has never been made, for reasons the soundness of which it is not difficult to understand, but with which we, at all events, have nothing to do. All I wish to point out is that as long as you only hear one side of the case, you must remember it is possible that there may be something to state in reply, I quite admit the force of Major Knollys' objections, as long as they are unanswered. But I would venture to suggest that objections are always apt to look unanswerable till they are answered. I came up here to-night, not to defend my own existence, so to say, but to give such experience as I have in relation to points to which the Lecturer has referred. There is one point on which our experience, I think, touched both the points which Sir Thomas Acland has brought forward in relation to the importance of leaving the selection of subjects in the hands of schoolmasters, and those which Captain Tulloch has brought forward in relation to the difficulties of instruction which he, and we, meet with, owing to the way in which men come to us from the public and other schools. Now I do think the accusation against the public schools, or rather against the education of the country generally, is precisely that which Sir Thomas Acland has alleged as an accusation against the non-commissioned Officers, and, I presume, to a certain extent against the Officers of the Army. What we complain of is not the subjects taught, but the method of teaching. It really matters to us very little what a man has been taught beforehand, for we have always to teach the special subjects ourselves; but this we do ask, that a man shall come to us who is in the habit of thinking, and who has not been so strained in his thinking that he shall look upon thinking as an awful operation, which is simply a matter of disgust to him. I confess I cannot express the cordiality with which I agree in what Sir Thomas Acland said about the importance of that part of the Eton education which is represented by boats and cricket, not in relation to the mere physical exercise, but in the training of thought and of mutual co-operation between men, which is connected with it. But I do think it is a terrible misfortune for our business, at all events that the sons of Eton should not more connect her in-door with her out-door teaching. I am not speaking of the picked men, but of the ordinary run of her men. What *we* have to do is, to give in-door teaching, which is *only* of value in so far as it is connected with the out-door teaching—with that very working of men with men. The whole point I find is this: a boy may, to put an, of course, exaggerated instance, know perfectly well that two and two make four, but try him with the datum, that there

are two men standing on parade, and there are two other men, and it will not occur to him that, as a matter of course, there are four men standing on parade. He has never been in the habit of considering that calculation, unless as a sum or an example, in which the men are as ideal as the figures. He has learnt it as a sort of thing which he has had to say by heart. Again, the test to which public schools are subject is entirely a different test to the one which we ought to set before ourselves. Public schools are tested by the number of Balliol scholars, the number of high wranglers, etc., whom they turn out. We do not attempt to turn out Napoleons and Wellingtons, for we cannot do it. The highest honours to be afterwards gained by those who come to us are not gained by mere instruction; but we require that no Officer should go from us who cannot use the commonest good sense in cases of difficulty. The complaint, I think, we should be disposed to make in relation to public schools, is that the tendency is to train the race-horses, and not to train the horses who are to do hard ordinary work. The whole force of the system is spent upon the showmen, and not upon the great body of the men. It is the great body of men who are important for our purposes. Mainly in relation to our special affairs at Sandhurst, is the mere preparation for the Officers who are to become the stock of the Army; all that we can do for them is to give them such information and training as will enable them, if they choose, to carry it on, and to learn anything else subsequently for themselves, and, as far as we can, to supply so much as that to *everybody*. But certainly with those who come to us, the mere training so simply, I think, has not been universal. Some of them are really afraid to put two and two together. I do not think you will arrive at what you want, by substituting arithmetic for classics. You must induce the habit of thinking, so that men may use their brains to some very small extent, just in so far as their brains will carry them, not to overstrain them, but that everything that is done should be a matter of thought, and not a matter of learning by rote. There is one other matter which Captain Tulloch has brought forward, on which I wish to speak, namely that in relation to the Reserve of Officers, because he and I suppose few others have a notion how the facts as to Sandhurst affect it. I do think it is a fact that wants thoroughly bringing forward, and which ought to be known about our College in connection with any discussion of the kind. Since the cadet system has been abolished, the effect has been, or will be in the next few years, to reduce the strength of the Army by something like 600 Officers, and for this reason. We are, I believe, to have something like a strength of 300 Officers at Sandhurst, going through their course of training. An equal number will always be undergoing their preliminary year. Every one of those Officers is reckoned on the strength of the Army. Not a single Sandhurst cadet ever used to be reckoned on the strength of the Army, but now, men who are taken absolutely for purposes of study, and who can by no possibility do any kind of regimental duty, are reckoned on the strength of, as if they were actually effective Officers doing duty with, their regiments. We talk about the small number of Officers in the Prussian Army, relative to the number of men, but there is not a single man reckoned in the Prussian Army, as effective, who is not doing duty with his regiment at the time. It simply makes the whole calculation absurd to ignore the facts as to whether you strike off 600 Officers or add them; you alter the whole calculation. A reserve of Officers in some way or other to be thrown into the Army as soon as war breaks out, is surely, as Captain Tulloch has urged so well, of the greatest importance. But before you enter into the calculation of how many and how effective Officers you could get from the Militia, you surely in the first place want that all those who are not really on the strength should not be reckoned at all. Every man who is not actually effective with the regiment should not be made to appear as if he were. Calculate your cadres in any manner you please, necessary for efficiency, but when you have them, let them be really what they pretend to be.

Major Knollys: I beg to explain to the gentleman who has spoken with reference to Sandhurst, that my remarks do not apply in any shape whatever to the method in which the system is carried out, but only to the general idea, the original notion.

Lieutenant Maurice: I did not mean to make the slightest remark reflecting on yourself, but merely to point out that there are moments when a scheme is in a merely experimental stage, and when the personal and general question becomes so intricately interwoven, that discussion cannot possibly be restricted to the general

question. Everybody must have heard what Mr. Cardwell said in the House the other day. The thing we should, from a personal point of view have wished, would have been an open inquiry. As soldiers, we are simply in the hands of His Royal Highness and Mr. Cardwell, but surely we may claim your indulgence when I say we think there may be something said in favour of the system. I do not think it is thoroughly understood that that is precisely the position in which the case stands. The question is in Mr. Cardwell's hands, not in ours. We have nothing to do but to leave it there. We are perfectly unable to say what might be advanced in defence of the scheme itself, because it would be impossible not to touch upon personal questions, which it seems right to those who know all the circumstances, and are responsible for the discussion, should not be entered upon.

Sir Harry Verney, Bart., M.P.: I think that we are much indebted to the gentleman who brought this subject forward, and to those who have spoken upon it, because they are particularly qualified to give an opinion upon that which I take to be one of the most important questions in the Army, the having a sufficient number of young Officers ready in case of war, men who are highly instructed, and who possess every advantage that can be derived from the practice, together with the theory and study, of military affairs. I was struck with the difference of opinion expressed by Captain Tulloch and Major Knollys with regard to the question of instruction at Sandhurst, or with the regiments. It is desirable that Officers should not lose the practice of the Army, while they receive instruction, but it is the opinion of Garrison Instructors that they would be better instructed when away from their regiments. This is a matter of great importance, and should be brought under the attention of the Commander-in-Chief and of the Secretary of State for War for their decision. There is one department of the Royal Army, perhaps the most important of all, which appears to me to be very inadequately attended to. It is extraordinary that our Intelligence and Statistical Department is able to produce as much information as they have done on many occasions, when we consider of how small a body it consists. I believe there are not above six or seven Officers in that Department, whereas in the Prussian "grossen "General-stab" there are about forty Officers who are constantly sent there from different regiments, and who acquire a perfect information on the various subjects presented to them. When at Berlin a couple of years ago, I remarked the perfect information which that Department contained. It made me reflect, how very little, comparatively speaking, we possess. We went into one room which contained ample geographical and statistical information on the countries to the east of Prussia; another department dealt with countries to the south; and a third with the western frontier and countries beyond it to the west. The Officer accompanying us said, "Now "would you like to see some of the maps which we send to each battalion taking the "field?" I said, "Certainly, very much." He said, "Where would you like to see "them? Name any part." I said, "I have just come from Sedan, and should like to "see that country, which I have visited." He took down a set of maps from a pigeon-hole, a bundle of 25 or 30, all upon linen, each map containing about 12 or 15 square miles. The woods and rivers were marked on it; every village, every stream, and the lines of hills in the neighbourhood. That bundle was to be sent to one battalion, and when the battalion leaves that part of the country they send back the maps and have another set of maps, 25 or 30, of the next district, giving a perfectly accurate description. That is a practice which we ought to adopt, and we might have it at a comparatively small expense. It is not that we have not sufficient Officers, but that Officers are not employed in getting that information which would give us the greatest advantage to achieve successes in war. Perhaps I am rather wandering from the question, which I understand to be, what should be the education of young men in the Army and of young Officers? I recollect an Officer who used to send his son to ride across the country, and then say, "Now sit down and "make me a sketch of the country you have been riding over. Tell me what hill "will command another. Point out to me how you think military manœuvres "might be carried on in this line of country, how a hill or line could be de-"fended or attacked." For a young man going into the Army, that is a very desirable sort of instruction, extremely interesting to him, as well as valuable in a professional view, and which might be given at a military

college. I was sorry when Sandhurst was abolished, I was there two years, as well as three at Harrow, and I thought at the time, and I think still, that every Cadet who became an under-Officer was perfectly fit to go on active service against an enemy after he had joined his regiment a week, if he had taken advantage of the instruction afforded at Sandhurst. We were there taught military drawing on the most perfect and complete system then known ; we learned quite enough of field fortification to enable us to command a company in war, and to throw up hasty earth-works, and also a certain amount of regimental drill. As has been so well said by those who preceded me, what you want in the Army and everywhere else is the exercise of the mind and the formation of character. By this competitive system, you may judge of men's intellectual capabilities, but you do not develop their characters, and it is character you want to command men, and for everything else in this country. We are particularly fortunate in having heard the opinions of those who have been engaged in this very pursuit, and I am sure any of us who are acquainted with what Sir Thomas Acland has done in his own neighbourhood will receive with great respect, and consider with attention, the suggestions he has made. I hope our sitting this evening will not terminate without hearing other gentlemen speak, who, like Lieutenant Maurice, have given their minds to this subject, because, after all, the important thing is to hear from men of thought and experience, and from some younger men, what they think most desirable for the education of Officers of the present day. It is to young men that we must look, and we value the opinion of those among them who have given their minds to their work and learned to take an intelligent interest in their profession.

Lieutenant W. H. JAMES, R.E. : As a young Officer who wishes instruction, may I be permitted to make a few remarks ? First of all as to the subject of field fortification, it has been said that young Officers do not know what field fortification is. Now, when I was passing, one of the examiners himself had not the faintest notion of the difference between a covered way and a double sap. He asked the question what a covered way was, and he thought it was a double sap.

With regard to public school education, it is pretty well admitted that hitherto it has to a certain extent failed in providing the necessary amount of educational training for Officers.* I think the London University admit this to some extent by their late rule omitting Greek from the matriculation examination. There is no doubt that most public schoolmen know nothing at all of Greek and Latin which they have spent the best years of their life in learning. Could I have, over again, the years which I unfortunately had to give to Latin and Greek, to devote to French and modern languages, I should have a chance of knowing much more than I can now possibly acquire. With regard to the next suggestion, there is a plan which is found to work well in India, and that is, offering rewards for passing in native languages. I believe a similar institution in England would be a good thing. Men passing in modern languages should receive a reward either in the shape of qualification for employment, or some remuneration for the time and money they must necessarily have spent in learning the language. I think some such plan would be found to work very well. There is another system followed out in Prussia, and that is, sending Officers on foreign tours. We all know that the information in the statistical department in the Prussian Army is entirely derived from sending Officers into countries in time of peace. All sorts of stories have been told in the newspapers about photographers in the Vosges mountains and in other parts of France previous to the late war. If we are to obtain information as to other countries, we must follow the Prussian example, and to do it, we must spend money.

C. E. H. VINCENT, Esq., late Royal Welsh Fusiliers : It was, my Lord, very late this evening, when I heard of this meeting, but I can only rejoice that the notice came in my way, for otherwise I should have lost much sound instruction from the paper of the gallant lecturer, and from the remarks of the Officers and gentlemen who have spoken on the subject thereof.

Captain Tulloch and Major Knollys appear to take great exception to the public

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* Owing to the fact that so much valuable time is wasted in acquiring the *most faint smattering* of Greek and Latin.

school education of England, as exemplified in the Officers of the Army. But, my Lord, I think you will agree with me when I venture to point out to them that the aim of public school training is not in the direction of the profession of arms; it is rather a general education on which can be subsequently built the speciality an individual requires. In this country, it is not customary, and happily so, to fix definitely upon a walk in life, at the early age when foreign parents call upon their children to come to a final decision respecting their course in maturer years. Therefore it is impossible for us to conduct elementary training in any specific groove. In Prussia, the young man who is going into the Army usually selects that career from the very first, and, entering the Cadet College at 10 years of age, his boyish days never witness any departure from a fixed method of training. In that military nation, the result, indeed, is satisfactory; but is it desirable for us to engraft the military despotism which there reigns supreme, into our free and extended institutions? If not, then how could geometry or the subjects which the garrison instructors present wish to have their pupils instructed in before they fall into their hands, be introduced into the public school system without infringing on its general character? Sir Thomas Acland instanced the high education of the Prussian "Einjährige Freiwillige." May be they do take precedence of our Sub-Lieutenants, but so they should do in their own interest, for a gladiator, in the intellectual arena of civil life, cannot be placed in the same category as the professional soldier. The "Einjährige," I must remind the hon. baronet, are not aspirants to military honours. They avail themselves of the one-year system only to free their necks from the military yoke in time of peace.

As regards the element of modern languages, it is, without doubt, of the utmost importance to give it greater prominence in all education, and this is being done; but for it to expel classics *in toto* from the field, would again infringe on the general system. The point of English composition and arithmetic is, perhaps, the most weighty in the discussion paper. That the former is terribly neglected is notorious and self-evident from even the most limited private correspondence. Were a high standard insisted on in all public examinations, the masters of schools would not be slow in turning attention to the subject. In respect to arithmetic, I should have thought a very respectable knowledge of it was actually necessary to pass any examination; but, be that as it may, no standard, however high, could infallibly keep equations in the head of Officers, and, as I understood one speaker, it was mainly the ignorance in this subject that he deplored.

The paper, in my hand, asks whether it would not be desirable to replace regimental instruction by one or two central schools. Does not the area over which our Army is scattered answer the question in the negative? With the concentrated army of Prussia, you can have concentrated schools, but with us, that hateful word "expense," must prevent it. Are we not all more or less interested in the reduction of national expenditure, with its coincident and identical diminution in the burden of taxation? None of you, gentlemen, can be anxious to increase the expenditure of the country, unless it is likely to give increased efficiency, and this the proposal holds out little hopes of. Were it adopted, with our army quartered all over the world, the locomotion of every rank would be no less endless than costly.

As to whether non-commissioned Officers ought to be more technically educated, few will give a dissenting vote; but I must venture to protest against the idea that another subaltern should be struck off the duty-roster. Officers of companies would look upon it as an obligation and a privilege to perform. Already, specialities bring regimental duty on a few only, and in addition to this evil, the soldier is disassociated from his immediate superior, which must be unfavourably looked on by all. The other questions as to Wellington College, &c., exceed my scope, even more than those I have already touched upon. I cannot, however, my Lord, sit down without saying one word more for the admirable public school system of England, with its general purpose, its unique moral and physical training. Does any Englishman wish us to sacrifice these for the severe discipline, slavery of mind and body, and comparatively narrow range of continental education? Surely, my Lord, it cannot be.

Sir Harry Verney: A friend of mine was taken prisoner by Napoleon, about the

time of the battle of Marengo. Napoleon kept him a fortnight, and found him to be a very nice young fellow, who had lately left College. I said to him "What did Napoleon talk most to you about?" "Oh," he said, "he asked me over and over again upon two points; there was nothing, he said, that he wanted to introduce so much into France as our public school system, and our country gentlemen." He said those were the two points on which over and over again, day after day, Napoleon asked for information.

Captain Tulloch (in reply): As regards the education of public schools, there is one thing, Greek, which I do not think need be so much taught to men not intended for College, and in that opinion, I consider, I am borne out by every one who has spoken on the subject in this Institution. Latin unquestionably is all very well; the Prussians omit Greek in all their examinations, but they retain Latin. With reference to the moral training of our public schools, I am sure there is no Officer in the Service but regards it with the very highest veneration. In the Navy, I observe the question of obtaining boys from public schools has been brought forward, and Admiral Ryder, in a paper on the Education of Naval Officers, says,—"Patronage "to first appointments in all public offices is being swept away. There can be no "reason why the Admiralty should not follow as regards the Navy afloat, but with "proper precautions. Let us assume that the First Lord is prepared to give up his "patronage, which many have considered a perfect nuisance, but says, as he may "well and rightly say, 'I will not consent unless the new scheme secures that the "'boys be, as a rule, gentlemen—that is, lads who have been brought up by and "'associated from their earliest years with persons who are recognized as gentlemen "'and ladies.' How can this be done? I say it can be done by aid of the *public* "*schools*. I doubt if it can be secured in any other way." Admiral Ryder then goes on to propose that the nominations to compete for naval cadetships (Queen's Cadets excepted) should be given to the public schools, according to the number of boys educated at each. With Admiral Ryder's view, I venture to agree most thoroughly, and wish much that such a scheme were possible for the Army; but as re ards the education which some boys get at certain public schools, I can hardly call it such, although the indoor work goes by that name; the evidence given before the Royal Commission on military education corresponds exactly with my own experience on this subject. The examiner in history and English, speaking of the examinations when they first commenced, says,—"I remember when the Archbishop of Dublin and "I examined 150 candidates, we only found 15 who were qualified at all: in fact "there was the greatest possible ignorance. There was no such thing as a standard, "and any answers we got were perfectly accidental." So much for public school education there. Touching the other more general points, another witness, a Colonel commanding a regiment said, "One of the defects was the want of sufficient attention "to the handwriting of candidates (Officers), which is sometimes so bad that, were "they soldiers in the ranks, I should hesitate to permit them to be non-commissioned "Officers, and in connection with the same subject, I may observe that it often "happens that young Officers display great difficulty in expressing themselves cor- "rectly in writing." The classical examiner, speaking in 1868, says,—"Formerly "men came, and you could not understand why they presented themselves at all "for examination, for they knew nothing; the number of such men has diminished." The Commissioners say to him, "You expected that taking young men who had "received a public school education, you would have found them more competent?" "It was astonishing to me how they could know so little." The mathematical examiner, in answer to a question, says, "I do not think that the public schools of "the country generally prepare all the youths who come from them with so much "mathematics as we require." "What is the amount of mathematics required?" "Very little." Further on, in answer to a question, he says, "Supposing that he (the "candidate) had to get his marks out of arithmetic alone, I think that there are "many boys in a first-class national school who would get the marks." With such evidence on public school education, I cannot think it may be said to be education at least as far as the boys who come into the Army are concerned. With reference to what Major Knollys said on garrison instructors lecturing on strategy and tactics, and their having time to do so, I only hope they may have sufficient time but at present they decidedly have not.

Major Knollys: I spoke of the future.

Captain Tulloch: The fact of a number of young fellows being at Sandhurst together is no objection to my proposition for having instruction carried out there, as they would be mixed up with a number of older Officers, and the whole scheme would be conducted as a garrison instruction class is now. Sandhurst was self-supporting only during a period when the Army estimates were cut down so unsparingly; when military education, and nearly everything else connected with the Service was withering under the blight of false economy, for which the nation paid so dearly in the Crimea. In the historical notice of the Military College, by Captain Hozier, given in the Appendix of the Report of the Royal Commission on Military Education, the Royal warrant states, "that the College is also intended to afford a "provision for the sons of meritorious Officers who have fallen or been disabled in "the service of their country, and the means of education to the sons of those "Officers who belong to our regular service." The old College of Sandhurst was undoubtedly a very great boon to the Service; Officers' sons were cheaply educated there. The new College has no more to do with the past College than that had to do with Hythe or Shoeburyness. The present College is under a new arrangement altogether, and the amount granted for the College just before the old order of things was brought to an end was a direct benefit to the Army: of this they have now been deprived.

As regards what Major Knollys said on Wellington College, I quite agree that education should be entirely general before entering the Service, and special afterwards. If a boy learnt what he might learn, there is no question but that his time would be fully occupied in his work at school; he would be taught his military subjects very much better when he joins the Service. Civilians and military men who have studied the subject are, I believe, all of one mind on that point, viz., that professional subjects should *not* be taught at school.

With reference to what Captain Rogers said about Wellington College, there is a feeling in the Army that the place is not as closely allied to the Service as it ought to be, considering that the Army were called upon to subscribe to it. The nation also subscribed to it as an Institution for the education of Officers' sons. I believe, in the first instance, it was intended for orphans, but surely if it is capable of giving a home to others than orphans, the rest of the College should be turned to account for Army purposes. Sons of Officers generally have to fight their way very hard in the world, and if they are associated with civilians' sons who may be extravagant in their ideas, as they certainly appear to be by the account given this evening, and I am strongly inclined to think that they are so even from the prospectus of Wellington College itself, the Officers' sons will be none the better for associating with boys richer than themselves. How it is that civilians get into Wellington College, and why are they there? I know not. If money is wanted for the College, and the case were properly represented, it could be got. The Army might subscribe again if the College were brought into closer alliance with it.

Sir Thomas Acland said that they do not make people learn sufficiently at Eton, and in that defect of public school education I venture to agree most perfectly. Boys who are wilfully idle are not compelled to work, but are allowed to do just as they choose. Over and over again I have asked my pupils about the different colleges. "So you were at ———?" "Yes, I was at ———." "What "did you do there?" "Oh, if I wished to work there were people to teach me, but if "I did not exert myself there was no compulsion whatever." What Lieutenant Maurice has said so entirely agrees with my own views that I need say nothing further on that head.

I will just refer to what the last speaker, Lieutenant Vincent, remarked about public school education being general. He states that if you teach geometry you would affect the general character of the school. The boys have plenty of time to amuse themselves, and to learn something as well, that is in addition to stringing together Latin verses, which appear to be about the principal occupation in some schools, *vide* letter from a public schoolmaster, Report of Military Education Commission, Appendix, page xxiii. In arithmetic, there is decided room for improvement. Certainly from the specimens I have seen of English composition from young Officers, the sooner greater pressure is put on schoolmasters to teach it the

better. With reference to the question of foreign service being against the establishment of the proposed schools of instruction, of course the present system of garrison instruction would have to be carried on till the proposed schools were in regular working order. Then as every Sub-Lieutenant would go to one of the schools before he went abroad, there would be no necessity for foreign instruction at all. If a subaltern is to be struck off duty, he would have, as a matter of course, to be made a supernumerary in the same way as the adjutant.

In conclusion, my Lord and gentlemen, I can only thank you for the very kind way in which you have listened to what I fear has been a tedious lecture, and I only hope that the discussion this evening will have some effect in drawing attention to the matter I have brought before you.

The Chairman: I suppose there will be great difference of opinion on some of the points brought forward, but there will be none I am sure on what I am about to propose, which is the thanks of the meeting to our gallant Lecturer for the very able discourse of the evening, and the extensive information he has given us.

Evening Meeting.

Monday, June 30th, 1873.

Vice-Admiral Sir FREDERICK W. E. NICOLSON, Bart., C.B., Vice-President, in the Chair.

ON THE GAME OF NAVAL TACTICS.

By Lieut. W. M. F. Castle, R.N.

On my arrival in England, a short time ago, I was much surprised to find that my name was connected with a "Naval War Game." I did not realise the great responsibility that my friends had incurred for me, and the great difficulties to be overcome, until I obtained the "Rules of the Conduct of the War Game," published by Captain Baring, R.A. I can hardly express my feeling after the perusal of these rules, for I saw at once that this "Land War Game" was the result of many years deep thought and hard work, and that my attempt at a "Game of Naval Tactics" can only bring us to the outline of a subject, so deep in its development, so complicated in its details.

However, having received an invitation from the Council of this Institution to read a paper on the progress that I had made in my game, I am here this evening, feeling how unworthy any effort of mine must be to add anything to the development of a science still in its infancy; but I hope that my endeavours to work out many of the details, will meet with the careful and lenient consideration of those who are interested in the movements of fleets, whether for the defence of our country, or the keeping up of that unparalleled historic name, which has been gained in a great measure through the vigilance, self-denial, intelligence, and hardihood of our seamen.

In explaining this game, I must ask you to place yourselves this evening in the position of a Commander intrusted with the command of a fleet during war. Your first study would then be to ascertain the steaming, the turning, and the fighting power of your ships, the object to be accomplished, the number and general character of your enemy; these are facts required in playing this game. Each player having digested them, he then forms a general idea of the power, &c., of the respective fleets, and in his dispositions will proceed as his

judgment directs. Any knowledge as to the ability of the opponent would also be useful, as it would enable him to use discretion in the performance of a hazardous strategic movement.

Should we be embroiled with a Foreign Power, not only would it be necessary to defend our own coast line, but it would be also necessary to afford protection to our colonies; under such circumstances the necessity of a thorough knowledge of the winds, prevailing currents of the ocean, coast line, accessible ports, facilities for coaling, and of numerous other facts indispensable to complete efficiency in a Commander-in-Chief and his staff, must be patent to any person who has given a thought in that direction.

We all know what weight a few well directed blows, aimed surely and scientifically, have in the result of mortal combat. So, in order that the leaders of our future fleets may strike boldly and surely, knowledge of the various powers and resources of the enemy must form an important element in the character of the attack. The Admiral must have the clearest possible conception of the power of each individual ship, and unbounded confidence in the ability of his captains, who in their turn should be animated by an *esprit de corps*, and a spirit of chivalrous respect for their Commander.

To be an active and efficient tactician would be of little worth, if the quality of a strategist be wanting, as I imagine the former would have only a small field, if any, to display his powers, if deficient in the latter quality. Therefore, I think I am right in saying, that to be a successful tactician, one ought to be a good strategist. The power of finding your opponent, meeting him at the greatest advantage to yourself and at the greatest disadvantage to him, involves weighty considerations, arrangements, and forethought. Such considerations, too, as in the day of battle, ought not to be left to the "chapter of accidents," which I much fear would be increased should any Commander be guilty of such indiscretion. For, instead of adding fresh laurels to those already so nobly won, England's naval glory would, I fear, be tarnished, and the historic reputation which at the beginning of this century adorned the annals of our Navy, would be sadly overshadowed. It is for this reason that I hope the consideration of this important subject may be facilitated in some small degree, if only by familiarising those who study their profession with the terminology and method of naval evolutions.

Should England be called upon to withstand invasion, I am of opinion that a numerous fleet of light draught, heavily-armed vessels of moderate speed would be most necessary and useful for the defence of our shores. As we already possess such a fleet, I shall pass them over without further allusion, and proceed to consider what part our ironclad, ocean-cruising fleet might be called upon to play. England's vital point is to be found elsewhere than upon our own coast line. She is dependent on her Colonies and merchant navy for the luxuries, aye, even the necessaries, of life. Were we engaged, therefore, with a naval Power of any pretensions whatever, it would not only be necessary to have a large fleet to insure free access to the Channel, and so render safe the arrival and departure of our merchant fleets,

but we should also have to keep a very careful eye in the direction of our great Colonies—Australia and New Zealand; for it is in these directions I think we have most to dread. Our colonists themselves are not altogether blind to this eventuality. Melbourne has set the example of buying heavy ironclad turret ships to protect her coast line. At this present moment Sydney has devised a very fair system of submarine mine defence. A young but intelligent colonial Navy is being trained, not for mere vanity, but looking forward, with that far-sightedness which has so distinguished the plodding, thriving colonies, to the time when England being attacked through them, they must bear their part in defence of fatherland.

Considering these facts, and that in all probability the scene of glory for the Royal Navy will not hereafter be confined more to our own shores than during former wars, I proceed to explain the game, hoping that my humble endeavours to work out the necessary details will meet with your kindest consideration.

I cannot lay sole claim to the idea of this game, for it was proposed to me by an old messmate* several years ago, his idea being to move little blocks, representing ships, over a chart placed on the ward-room table; the idea soon dropped, but the very great success of the German KRIEG-SPIEL, and the invitation to express my ideas before the members of this Institution, led me to attempt the working out of the proposed game during the few unemployed hours at my disposal.

The strategic portion of this game may be carried out on the ordinary chart, such as is supplied to ships, for it is nothing more than a problem. Given certain facts with regard to the single relative and collective power of ships, coal-carrying capabilities, proximity or otherwise of land, season of the year, object to be accomplished, points at which mails are to be intercepted, stations at which colliers are to be met, and a host of various other details, a knowledge of which would add to the confidence of the Commander in the arrangements made at home for the efficiency of his squadron: these are the data. An acquaintance with them is indispensable to prevent embarrassing disappointments, which tend to affect the morale of a squadron longing to render a good account of the expected enemy.

"The Game of Naval Tactics" is not a study of fancy moves, and imaginary formations, for I have devised it for use in connection with the General Signal Book; and, to be played to any real purpose, the game requires great patience and attention, strict adherence to the rules laid down, and also great accuracy on the part of the players. Thus each move and consequent change of position is studied with as much care as if real squadrons were being manœuvred. In fact, we must try to assure ourselves of the practical character of the circumstances as laid down in the problem to be worked out.

I have chosen for convenience, as I shall show presently, a square space enclosed by lines representing 16 nautical miles in length. This space is of convenient size, as it is capable of representing an area enclosed by 16, 8, or 4 nautical miles. This change of scale can be

* The Rev. Fred. Davies, M.A.

made at pleasure, and will be found convenient at certain stages of the game. Thus when a series of movements have been made by both squadrons, but, owing to the smallness of the scale and the proximity of the ships, the space is found to be insufficient, both parties may agree in suggesting to the umpire that the whole area be taken as representing a space enclosed by lines 8 or 4 instead of 16 miles in length, and the position of the ships can then be relaid and the game continued. This change of scale will be convenient, as it will make the effect of the different movements more perceptible. The advantage of the larger scale will be seen should two ships be so placed with regard to each other that ramming is imminent.

Again, a chart representing the small scale area will also represent the distance at sea, at which vessels would be out of sight of each other. I have experienced much difficulty in arranging a scale large enough to represent the track of a ship, or leading ship of a squadron or division, when altering course any number of points to starboard or port; but I have adopted the scale shown as the nearest and most sufficiently exact measurement for that purpose. Many experiments have been tried at various times during evolutionary cruizes to measure the diameters of the circles made by ships when turning completely round at various speeds, and I think it has been generally accepted that the modern type of ironclad makes a complete circle, the diameter of which is about three and a half times their length. The circle is not, however, quite complete, as the ship generally finishes slightly inside the original starting point.

Another difficulty presented itself,—the very great difference in length between ships of the various classes which would probably form the line of battle. During the autumn of 1869, the combined fleets, consisting of the Channel and Mediterranean Squadrons, with the Admiralty Flag flying at the "Agincourt's" main, were cruising off the mouth of the River Tagus; each class of ironclad ship was represented in this squadron, and each varied considerably in length. I have, therefore, for the present, struck a convenient average—300 feet.

Another difficulty arises from the difference of the diameters of the circles made by the various ships when turning. Some have balanced rudders, others ordinary ones, and some, perhaps, rudders moved by Rear-Admiral Inglefield's hydraulic steering gear.

Owing to the complications that would have arisen in making many different scales to represent the turning arc of each class of ships, under various speeds, I have taken 8 knots as the average speed at which a ship moves through the water when turning. Although I have named this speed, the player is at liberty to suppose any other he may consider most consistent with the data previously laid down.

It may appear to many that I have spoken rather indefinitely on the before-mentioned points. I have not, however, had access to any official records of turning circles, except those of the Channel Squadron during the autumn of 1867, but I have obtained much trustworthy information from Captain Colomb's papers published in the journals of this Institution, more particularly from his paper on "Modern Naval Tactics." For reduction of speed during turning, I have taken the "Bellerophon,"

a ship of 300 feet, as an average example, and I find that her speed, when steaming 12 knots, was reduced when actually turning, to nearly 8 knots an hour. This and a similar experiment made by the "Lord Warden" at 10 knots, I think justify me in considering 8 knots as about the average speed a ship makes when turning a circle. I have not thought it necessary to trouble the meeting with any speeds under 10 knots.

The object of the game is to facilitate the study of the evolutions, laid down in our present Evolutionary Signal-Book; and to familiarise Officers with the mode of performing them; with the time and space that a few combinations must occupy; and with the points to be attended to or to be avoided in actual practice.

It may be thought that a method of showing by scale the various movements of a squadron of ships is unnecessary, prior to contact with the enemy, since, with steam, so long as we can hold our fleet in hand, and have it ready, a host of preliminary evolutions may be superfluous. Some Officers of known experience are of opinion that on sighting an enemy, it is only necessary to form groups, that is, pelotons of three or four ships, and attack the wings, avoiding the main body, and when a suitable distance to their rear, to retrace one's steps and prepare to repeat the same tactics; others prefer the old line of battle. But a Commander-in-Chief may have other objects in view,—he may be weak, he may expect assistance and support from a friendly force, perhaps dispersed for the purpose of gaining information of the enemy, and it may be necessary to postpone a general and bold advance. His objects in delaying the fight may be many, but still these are not the points I wish to bring before you this evening, for I take it for granted that the various evolutions, illustrated in the Signal-Book, have each their special intention.*

In the preliminary arrangements of the game, it is open to the students or players to decide at what speed the circles should be described by the whole squadron, but I have taken 8 knots, as I said before, as the average speed in turning. It is, however, always possible to arrange the scale for any speed that circumstances may require and the position will admit. It rests with the students to select from an imaginary fleet the description of ships they prefer to form their squadrons, say, so many "Devastations," "Cyclops," "Sultans," "Vanguards," "Monarchs," or "Glasgows."

I do not intend this evening to bring the squadron into actual contact, but explain the principles on which the game is founded, hoping that, should a discussion follow this paper, I may learn something practical, which will prove of assistance in the further development of this game. I will now proceed to read the rules, and explanations of the various tables, scales, &c.

The Playing Board (Plate I).

The board on which this game is played is 64 inches by 64 inches. Lines are drawn 4 inches apart across the board from side to side, and

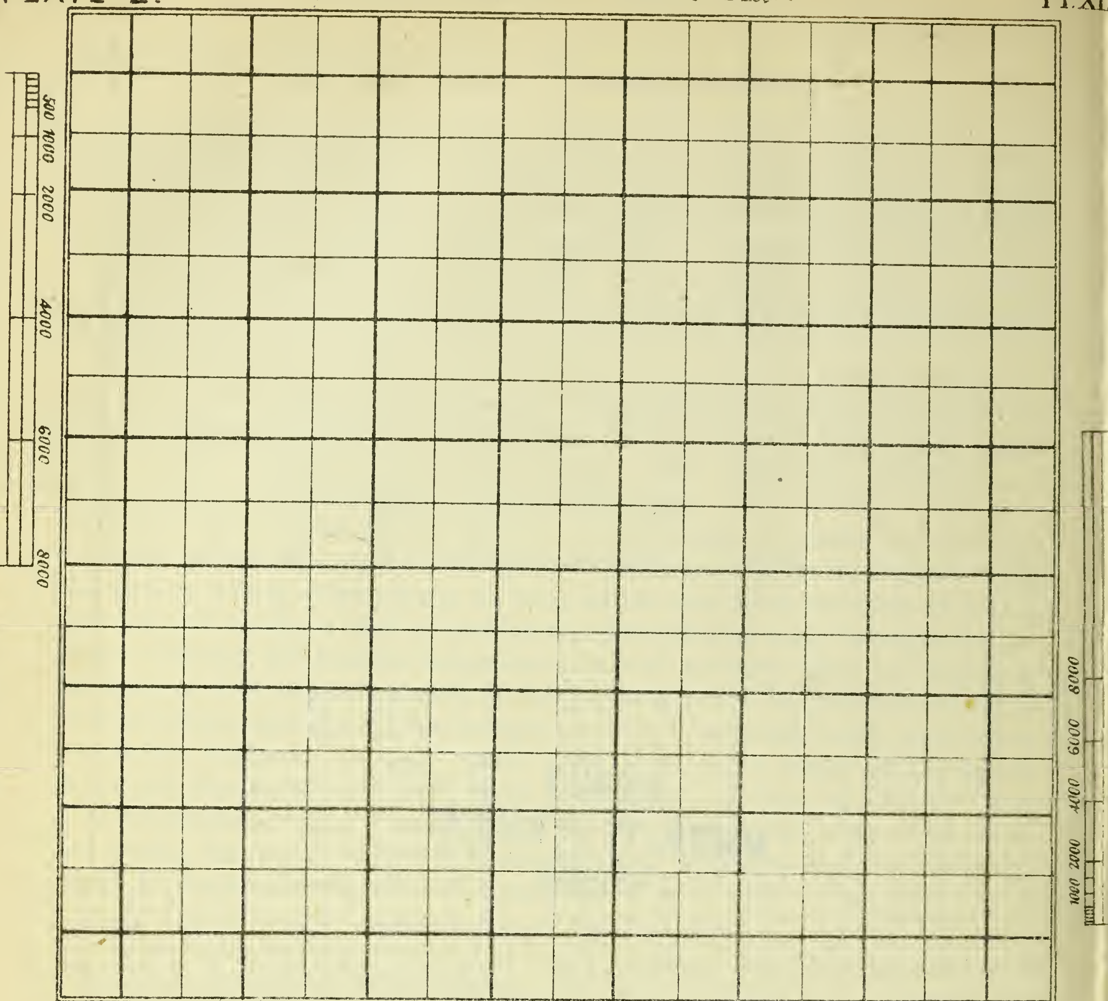
* Since this was written, I have learnt that a great change is about to take place in the "Evolutionary Signal Book."

Journal R.U.S Institution
Vol. 17.
PLATE 2.

Playing Board.

1/4 inch to 4 inches or 1 Nautical Mile.

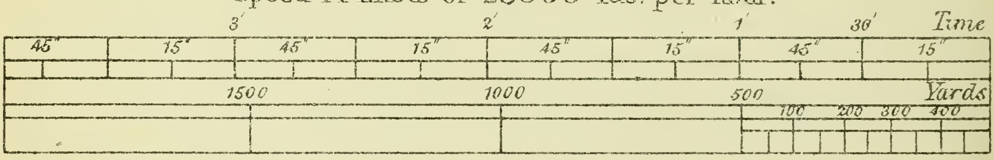
Side Scale when Two divisions represent One Nautical Mile.



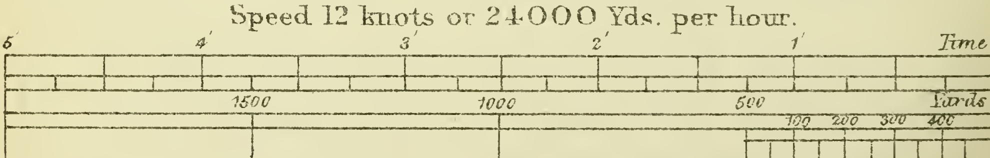
SCALE I

To be used when each Division on the Board represent One Nautical Mile.

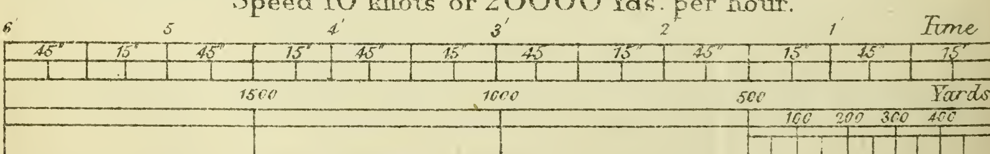
Speed 14 knots or 28000 Yds. per hour.



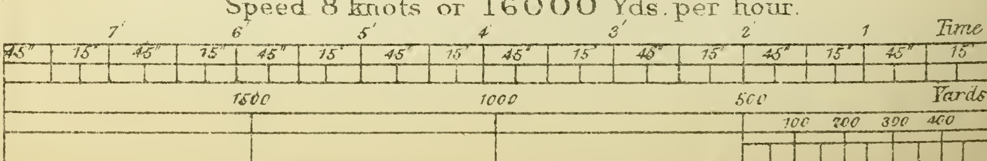
Speed 12 knots or 24000 Yds. per hour.



Speed 10 knots or 20000 Yds. per hour.



Speed 8 knots or 16000 Yds. per hour.

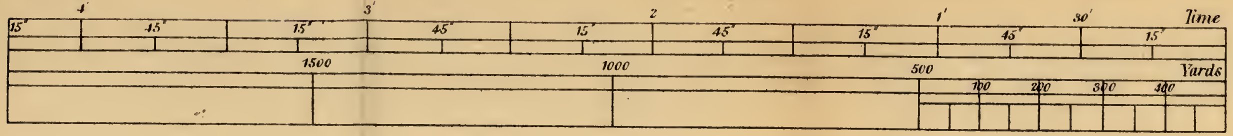


SCALE II.

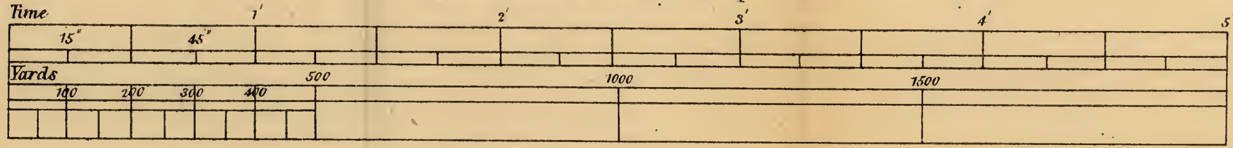
To be used when Two Divisions on the Board represent One Nautical Mile.

PLATE I.

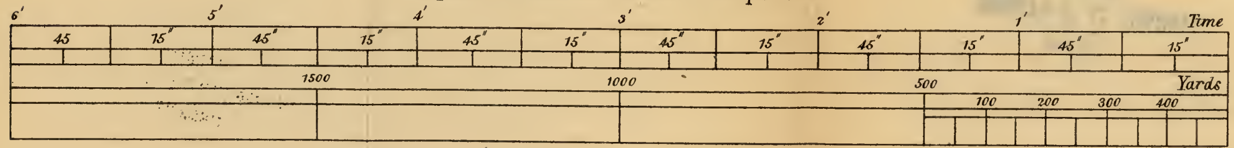
Speed 14 knots or 28000 Yds. per.



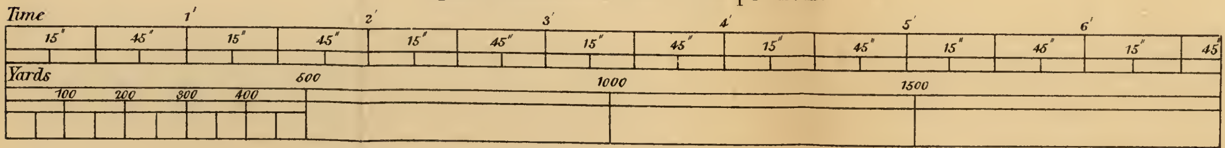
Speed 12 knots or 24000 Yds. per hour.



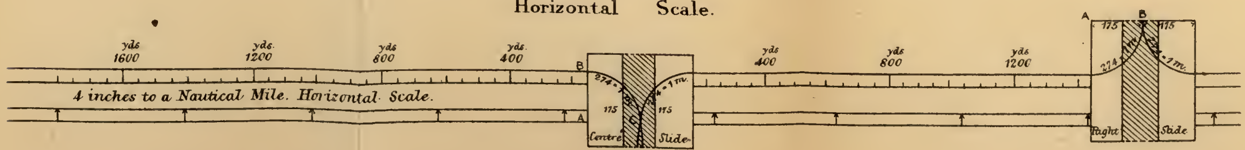
Speed 10 knots or 20000 Yds per hour.



Speed 9 knots or 18000 Yds. per hour.



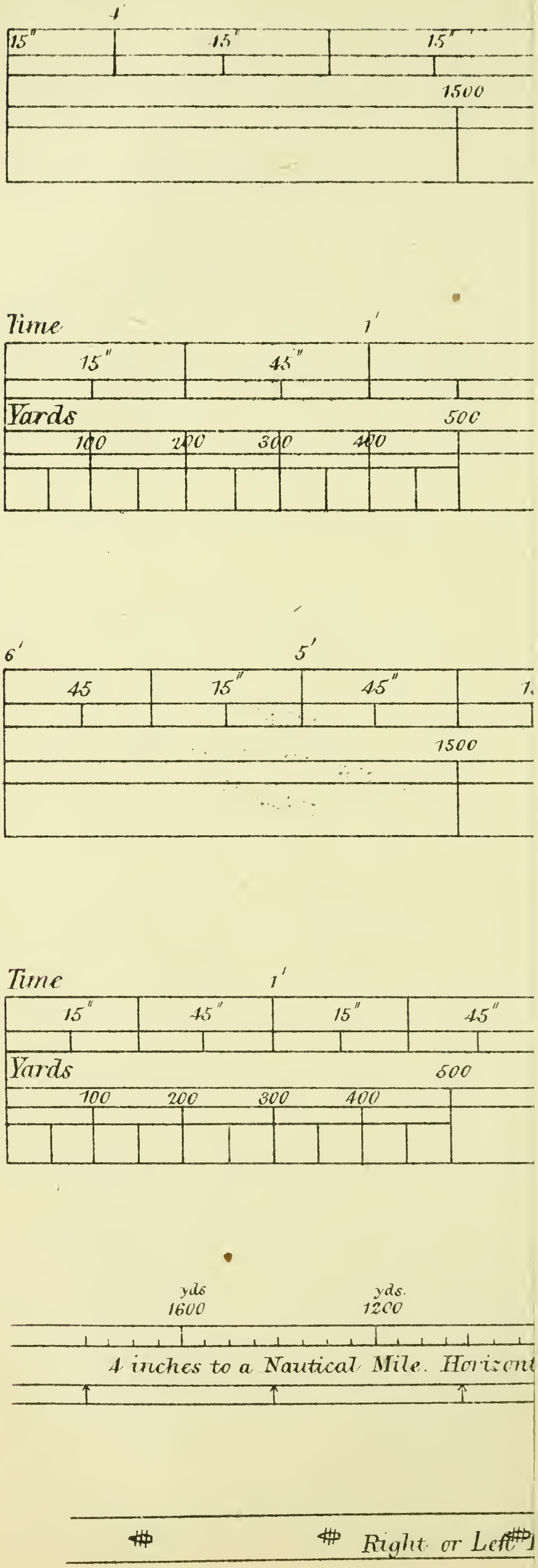
Horizontal Scale.



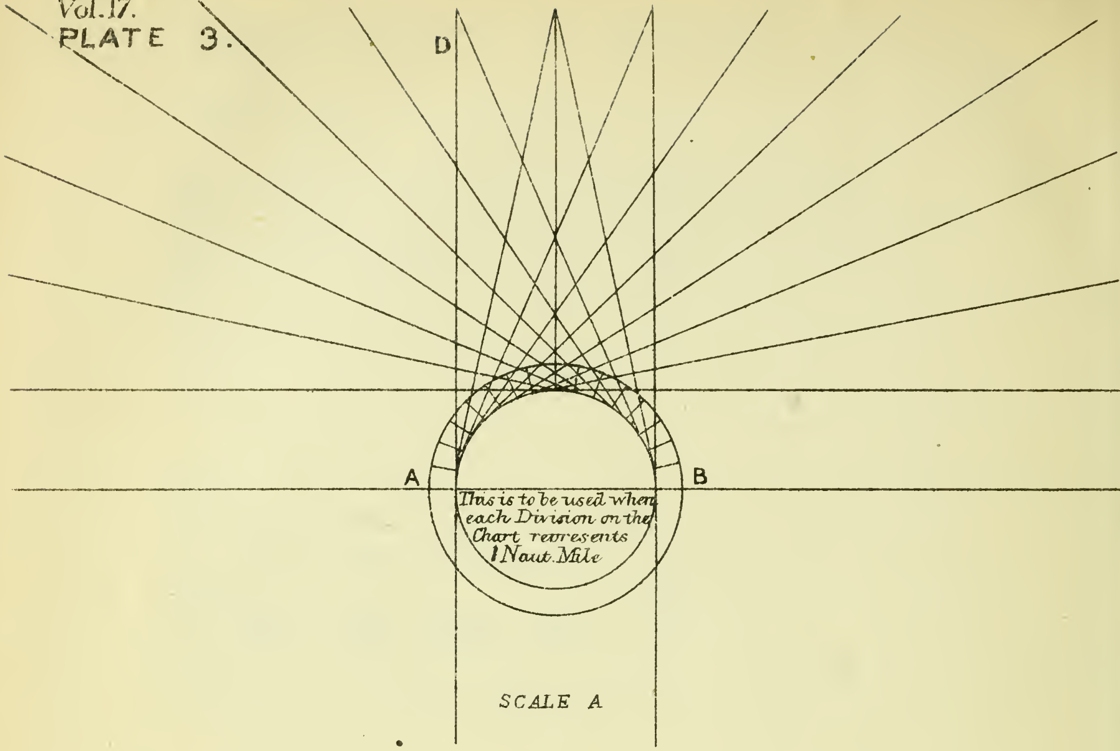
Journal R.U.S. Institution
Vol. 17.

To be used

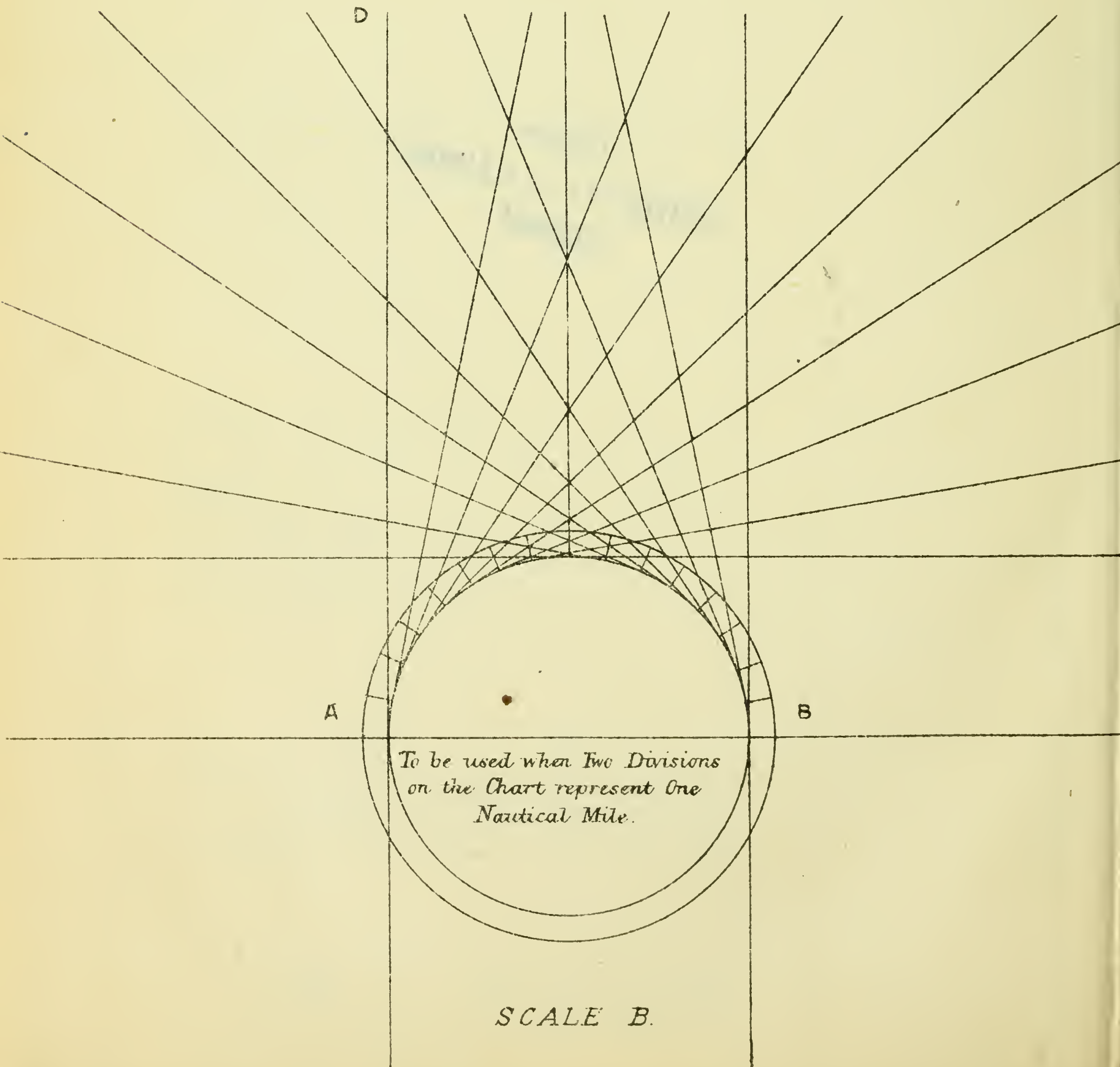
PLATE I.



Harrison & Sons Lith St Martins Lane W.



SCALE A



SCALE B.

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also others at right angles to these lines. The distance between each pair of lines represents 2,000 yards, or a nautical mile. In order to facilitate the counting of the several divisions, every alternate line is drawn in red ink. The board therefore represents a space enclosed by lines 16 nautical miles in length; or it may represent a space enclosed by lines 8 nautical miles in length. Again, it may represent a space bounded by lines representing 4 nautical miles; in this case *four* divisions represent one nautical mile.

The scale on the left side of the board represents the nautical mile 4 inches in length; it is divided into divisions of 500, 100, and 50 yards. On the right side of the board is a scale representing the nautical mile 8 inches in length; the scale is divided as the other.

The board, for convenience of packing and general use, is made up of 16 blocks of paper, each block being 16 inches square and 12 sheets of paper thick, on the same principle as a drawing block, so that when one surface of paper has been used, it can be removed and the board be ready for a new game.

The markers for noting the position of the ship upon the playing board are made of thin flat lead; the distinguishing colour and fleet number of the ship they are intended to represent, is fastened to them,—a pin secured to the body of the marker, facilitates its manipulation. The markers are made a convenient size, but should it be necessary on the playing board to represent the exact dimensions of a ship, an outline may be drawn to the scale of the unit that the board represents, viz., on the full sized board ·19 of an inch, when two divisions represent 1 nautical mile ·38 of an inch, when four divisions represent 1 nautical mile ·76 of an inch in length.

The leaders of each squadron bears a flag, either RED or BLUE, fastened to the head of the pin.

Scales 1, 2 *and* 3 (Plates I and II).

Scale 1, Plate I, represents four different speeds, viz., 14, 12, 10 and 8 knots, and is used on the full-sized board for measuring the distances corresponding to certain times. The lower edge is marked in yards, the upper edge in minutes and seconds; so that, when a certain distance has been run, the time occupied is easily found, or, if a ship has moved at a known speed for a certain number of minutes, the corresponding distance can be found.

Scale 2, Plate II, is on the same principle as Scale 1, and is to be used when TWO divisions on the board represent ONE nautical mile.

Scale 3, if constructed, would be on the same principle as Scales 1 and 2, and would be used when FOUR divisions on the board represent one nautical mile.

Altering Course Scales (Plate III).

SCALE A to be used in combination with SCALE 1, *i.e.*, when each division on the board represent one nautical mile. The scale is constructed on the following principle: suppose the average length of the

representative class of ironclad to be 300 feet, and that her speed when turning a circle is reduced to 8 knots. The average diameter of this circle being $3\frac{1}{2}$ times her length. The number of yards described in the circumference of the circle may be easily calculated—

$$\text{thus } 3{\cdot}5 \times 100 \times 3{\cdot}1416 = 1099 \text{ yards (about).}$$

Dividing this circumference by 32, the number of yards contained in each compass point is found. Table B, has been constructed on this data.

SCALES B and C are constructed on the same principle as SCALE A just explained, and would be used when *two* or *four* divisions on the board represent respectively one nautical mile.

When altering course ONE or ANY number of points to starboard, select either of the scales, A, B or C, according to the unit of measurement in use; place the left hand corner *A* so that the horizontal line A B touches the stern of the ship; the line A D in the same line as her course; count off the required number of points to the right (for instance, 5 points), follow the line radiating from this point of compass to the board, there make another pencil mark, then remove the scale, and join these two points. The line joining these two points will represent the new course of the ship.

Horizontal Scale (Plate II).

A most useful scale for all rectangular formations.

A separate scale of this description is required for each unit of measurement. They are divided into three parts, viz., horizontal bar, slides, and perpendicular scales. The horizontal bar is about 12 inches long; the upper edge is divided from the centre at each 50 yards; the lower scale is divided from the centre at each 400 yards; the divisions on the latter scale are called CORRECTION MARKS. The right or centre slide is adjusted to either of these correction marks; according to the distance the columns are to be apart when moving from SINGLE COLUMN in line ahead to COLUMNS OF DIVISIONS in line ahead. An example of its use will be given later in this paper.

The indentations on the perpendicular scale represent ships; they are each 400 yards apart. A few other ordinary scales are required, such as a long straight edge, parallel rulers, and a box of mathematical instruments.

TABLE A.

Table A. This table shows the NUMBER of yards a vessel will pass over the water in calm weather during a known time at a known speed. Its use requires little explanation; it would be principally used when measuring long distances. Knowing the time a ship proceeds in a direct course, and the speed, the DISTANCE is easily found. For instance, moving at 10 knots per hour for ten minutes, the distance by Table A = 3,333 yards. To measure this distance on the Playing Board (Plate I) refer to the *side scales*.

TABLE A.—*Distance in Yards that a Ship moves at a given speed during a given time.*

Knots.	m. 60	m. 50	m. 40	m. 30	m. 20	m. 10	m. 9	m. 8	m. 7	m. 6	m. 5	m. 4	m. 3	m. 2	m. 1	sec. 45	sec. 30	sec. 15	sec. 10	sec. 5
14........	28,000	23,330	18,664	14,000	9,332	4,666	4,200	3,932	3,282	2,800	2,333	1,866	1,400	933	466	358	233	116	76	38
13........	26,000	21,667	17,335	13,000	8,666	4,333	3,900	3,467	3,033	2,600	2,166	1,733	1,300	866	433	324	216	108	72	36
12........	24,000	20,000	16,000	12,000	8,000	4,000	3,600	3,200	2,800	2,400	2,000	1,600	1,200	800	400	300	200	100	66	33
11........	22,000	18,330	14,666	11,000	7,333	3,666	3,333	2,933	2,582	2,222	1,833	1,466	1,111	733	366	273	183	91	61	30
10........	20,000	16,667	13,332	10,000	6,666	3,333	3,000	2,666	2,331	2,000	1,666	1,333	1,000	666	333	249	166	83	54	27
9........	18,000	15,000	12,000	9,000	6,000	3,000	2,700	2,400	2,100	1,800	1,500	1,200	900	600	300	225	150	75	50	25
8........	16,000	13,330	10,666	8,000	5,333	2,666	2,400	2,133	1,882	1,600	1,333	1,066	800	533	266	198	133	66	44	22
7........	14,000	11,665	9,332	7,000	4,666	2,333	2,100	1,966	1,641	1,400	1,166	933	700	466	233	179	116	58	38	19
6........	12,000	10,000	8,000	6,000	4,000	2,000	1,800	1,600	1,400	1,200	1,000	800	600	400	200	150	100	50	33	16
5........	10,000	8,333	6,666	5,000	3,333	1,666	1,500	1,333	1,165	1,000	833	666	500	333	166	124	83	41	27	13
4........	8,000	6,665	5,333	4,000	2,666	1,333	1,200	1,066	941	800	666	533	400	266	133	96	66	33	22	11
3........	6,000	5,000	4,000	3,000	2,000	1,000	900	800	700	600	500	400	300	200	100	75	50	25	16	8
2........	4,000	3,332	2,666	2,000	1,333	666	600	533	470	400	333	266	200	133	66	48	33	16	11	5
1........	2,000	1,666	1,333	1,000	666	333	300	266	235	200	166	133	100	66	33	24	16	8	5·5	2·5

Table B.

Table B gives the *time* and *distance* in which a ship will describe a *whole circle or any portion of it* when the helm is put to starboard or port, and is based on the experiments carried out by the Channel Squadron off the coast of Portugal, 6th and 7th November, 1867. This table will be always used when changing course; for instance, alter course 5 points to starboard, time occupied by Table B = 38 seconds.

Portion of circle.	Distance.	Time. min.	Time. sec.
32 points................	1,090 yards.	4	7
16 "	545 "	2	3·5
8 "	272 "	1	1·7
7 "	238 "	0	53
6 "	204 "	0	46
5 "	170 "	0	38
4 "	136 "	0	30
3 "	102 "	0	23
2 "	68 "	0	15
1 "	34 "	0	7·7

Table C.

Table C shows the *time* which a column of ships will take to form *columns* of *threes* from LINE AHEAD at different speeds.

Knots.	6.	7.	8.	9.	10.	11.	12.
	min.	min.	min.	min.	min.	min.	
12............	2·83	3·23	3·86	5·24	7·82	15·47	
11............	3·25	3·91	5·28	7·84	15·49		
10............	4·03	5·30	7·86	15·52			
9............	5·32	7·88	15·54				
8............	7·93	15·56					
7............	15·60						
6............							

The tables are all constructed on the same principle.

In Table C, the upper line of figures in each table represents the speed of the leading ship; the figures in the side column, the speed of the vessel which has to move over the longest distance. To use this table, suppose the speed of the leading ship or column to be 6 knots, the speed of the ship which has to steam over the longest distance to be 9 knots; by entering Table C along the top column, with the speed of the leader, and the side column with the speed of the last ship, the time required, viz., 5·32 minutes, is found.

Or again, for example, suppose the Fleet to have been steaming in ONE OR MORE columns in line ahead at 10 knots, and the signal is made for columns of THREES, the leader reduces his speed from 10 knots to 6; the rear ship has a small reserve speed, and consequently steams 11 knots, then by Table C the time is found to be 3·25 minutes.

Table D.

Table D shows the time which a column of three ships will take to form *groups* from LINE AHEAD at different speeds.

Knots.	6.	7.	8.	9.	10.	11.	12.
	min.	min.	min.	min.	min.	min.	
12............	1·08	1·22	1·42	1·73	2·38	3·94	
11............	1·26	1·45	1·79	2·42	4·02		
10............	1·5	1·82	2·45	4·29			
9............	1·89	2·52	4·36				
8............	2·6	4·45					
7............	4·6						
6............							

Table E.

Table E shows the time that six ships may form the *indented line*, from COLUMNS OF DIVISIONS IN LINE AHEAD, at various speeds; ships in close order.

Knots.	6.	7.	8.	9.	10.	11.	12.
	min.	min.	min.	min.	min.	min.	
12............	2·31	2·36	2·45	2·57	2·78	3·14	
11............	2·55	2·65	2·76	2·98	3·38		
10............	2·85	2·93	3·22	3·66			
9............	3·26	3·54	4·00				
8............	3·86	4·39					
7............	4·91						
6............							

Table F.

Table F shows the time that six ships may form the *indented line* from COLUMNS OF DIVISIONS IN LINE ABREAST at various speeds; ships in close order.

Knots.	6.	7.	8.	9.	10.	11.	12.
	min.	min.	min.	min.	min.	min.	
12.	4·62	5·5	6·89	9·15	13·69	26·9	
11.	5·53	6·9	9·16	13·7	27·0		
10.	6·91	9·17	13·71	27·1			
9.	9·19	13·73	27·2				
8.	13·74	27·3					
7.	27·4						
6.							

General Rule for use.—Enter the upper column of knots with the speed of the leader of division, the side column of knots with the speed of the ship which has to pass over the longest distance, and the corresponding time is found.

Appended to this paper are the equations by which these tables have been formed.

Should this "Game of Naval Tactics" find few friends, yet I hope that these little tables may prove useful, for if embodied in the Evolutionary Signal-Book, they might be used as a guide, when performing evolutions in actual practice.

Table G.

Table G shows the DISTANCE in yards that the last ship of a fleet, when steaming in SINGLE COLUMN IN LINE ahead, will have to steam over, to take her new station *in line abreast.* To use this table, enter the *side* column with the fleet number of the last ship, the top column with the order (close or open), then refer to Table A with the known speed and known distance, and *the time* for the evolution is found.

No. of Ships.	Close order.	Open order.	Remarks.
	Yards.	Yards.	
2.	565	1,130	
3.	1,130	2,260	
4.	1,697	3,390	
5.	2,260	4,520	
6.	2,828	5,650	
7.	3,493	6,780	

Rules for the Students or Players.

The students to consist of five persons, viz., one umpire, two principal players and two assistants,—the principal players are to name all moves. Each move to count for two minutes of time. The principal players will be furnished with several slips of papers (Form 1), on which they will communicate their intentions in writing to the umpire. Each player writing in a different coloured ink.

Form 1.

Colour of player.	Number of moves demanded.	Evolution.	Speed.	Remarks.	Times, &c.	h. m.
					Players' entry..	
					Umpire's „ ..	
					Termination of evolutions	

A player may claim five moves at one time. He may claim a new move before the move that he is making is finished; but this move cannot be commenced until the time for the last movement has expired. Should a player, in writing his intention, fail to use the terminology of the Signal-Book, the mistake should at once be called attention to by the umpire, who will delay the execution of the movement half a move (*i.e.*, one minute); this is most important, as in practice any mistake in signals delays the evolution and causes endless confusion. During delays the ships will continue to move on in their original formation.

Should a player wish to increase or decrease the speed of his ships, he may do so two knots, by telling the umpire and the assistant player of his own side his intention; but should he wish to proceed at such an increase of speed as would in actual practice entail more boiler power, he must claim ten moves, communicating his intention to the umpire in the usual manner.

The umpire's decision under all circumstances is to be final. He should furnish the leading players with a special idea, written distinctly on paper, naming the object to be accomplished, the time allowed for the execution of this duty, the place at which coals may be procured, mails met, reinforcements found, ports that have to be closed; those that have to be defended, extent of cruising ground, proximity of land or shoal water, strength of the opposing force, their position on a certain date; in fact he must supply each player with as much intelligence as would probably be communicated to the commander of a squadron ordered away to form a portion of a combination. He will keep an account of the moves made by each player on Form 2.

After having registered the move demanded, as will presently be explained, the umpire will give the player's assistant the slip of paper (Form 1), in order that the movement on the board may be marked off. No move is to be made until one move (two minutes) has elapsed since the receipt of the notice. The umpire must check any undue haste on the part of the players, and prevent either making too many moves in advance. He must prevent talking or observations by either side which will hint to either party any information; he may stop

the game whenever he may think it necessary in order that the assistant players may mark up the relative position of each squadron. After stopping the game, the umpire may limit the number of moves; this will be found necessary when the opposing ships are in close proximity. On the receipt of the slip of paper (Form 1) from the principal player, the umpire should note the interval of one move upon it, and then pass the paper to the assistant player. For instance, Red at 10h. 14m. demands three moves; under the time entered by the player, the umpire notes the interval of one move, also the time for completing the evolution, in the following manner:—Form 1, players' entry 10h. 14m., umpire's 10h. 16m., evolution finished (three moves for evolution) 10h. 22m.

Form 2.—Register of Moves.

Form 2 illustrates the table in which the Umpire keeps the record of the moves.

Red.				Blue.			
Move column.	Hour.	Evolution.	Remarks.	Move column.	Hour.	Evolution.	Remarks.
1	1	A.M.		1	1	A.M.	
2	2			2	2		
3	3			3	3		
4	4			4	4		
5	5			5	5		
6	6			6	6		
7	7			7	7		
8	8			8	8		
9	9			9	9		
10	10			10	10		
11	11			11	11		
12	12			12	12		
13	1	P.M.		13	1	P.M.	
14	2			14	2		
15	3			15	3		
16	4			16	4		
17	5			17	5		
18	6			18	6		
19	7			19	7		
20	8			20	8		
21	9			21	9		
22	10			22	10		
23	11			23	11		
24	12			24	12		
25				25			
26				26			
27				27			
28				28			
29				29			
30				30			

Red's moves are registered in the left columns.

Blue's moves in the right columns.

The column numbered from 1 to 30, is arranged for recording moves, two minutes to each move; the column numbered from 1 to 12 a.m., and 1 to 12 p.m., for recording the hour; the " evolution" column for recording the evolutions; " remark " column for remarks.

Suppose we wish to register a move, commencing at 10h. 14m. a.m., place a pin bearing the colour of the player in square 10 of hour column, this registers 10 hours ; place another pin in 7 square (move column), this registers the minutes, viz., 14m. Supposing the player to claim 3 moves, the umpire places another pin in square 11, thus registering the one move imposed by the umpire (as was before explained) and the number of moves demanded, viz., 3. By this means we have registered 10h. 14m.; also 10h. 22m., the former being the time at which the evolution was commenced, the latter the time when the evolution is finished; any remarks that the umpire may think necessary should also be entered.

Should the umpire impose the fine of half a move (that is 1 minute), the minutes in the move column, if previously even, will become odd; when marking odd minutes, place the pin on the line between the squares in "move" column.

Since the registering of seconds would involve some complication, the nearest minute must be taken, or dice may decide whether it shall be the minute just elapsed, or the next in advance.

By these means the umpire regulates the moves, and checks a player making too many moves in advance, or getting too many moves in arrear of his antagonist.

The record of blue is kept precisely in the same manner.

Relative Speed Table for Sailing Ships.

Since ships, whether ironclad or otherwise, may cruise under sail, it is necessary that the umpire should have some rules furnished him for treating such cases.

Ships under sail, with the wind free, may be supposed to move with greater speed than those close hauled.

Description of Vessel.	Force of wind.	On a wind.	Free.	Remarks.
		Knots.	Knots.	
Frigates (wood cased or otherwise)	4 to 6	5	7	This table represents the speed of ships under ordinary conditions. The umpire must state all circumstances of the weather, if ships are under sail, when he names the time of sighting one another.
Ironclads.........	,,	4	6	

Under ordinary circumstances, the umpire may allow 16 minutes for a fleet to prepare for action, and to have steam ready for 8 knots.

Example of the Use of the Horizontal Scale. (Plate II).

Suppose fleet in single column in line ahead.

The player of the red squadron intends FORMING COLUMNS OF DIVISIONS IN LINE AHEAD, ships turning to starboard (Plate IV).

The player hands the slip of paper (Form 1) to the umpire, correctly written up (as previously explained) ; this represents the signal being hoisted. The umpire detains the paper and adds to it, the interval of one move, then passes it on to the assistant player. (This represents the signal being hauled down.)

The assistant player first selects the horizontal scales for the unit of measurement, and places the centre slide immediately over the position of the leading ship ; the horizontal scale being at right angles to her course. He then moves the right slide to the third correction mark, and transfers the position of the right division to the playing-board. The position of the left division may be marked off by measurement, each ship abreast of her opposite neighbour. In order to find the time that this evolution will take to perform, the assistant-player refers to Table B for the time of two changes of course at right angles, viz., 2 m. 1 sec. ; he next counts the number of hundred yards between the inner edge of the centre and right slide, viz., 850 yards. Then suppose speed of ship to be 8 knots, 850 yards at 8 knots = 3 m. 12 sec. ; whole time occupied in performing evolution = 5 m. 13 sec.

Example of the Use of Tables C and D.

I have classified Columns of Threes and Groups under the same head.

Tables C and D give the least time that these evolutions can be performed under the most favourable circumstances, at various speeds ; in actual steam evolutions these tables would be of little use, except as a reference and a guide. But in playing this game, since the umpire may decide the practicability of any evolution, it necessitates some exact data to start upon.

Fleet in COLUMNS OF DIVISIONS IN LINE AHEAD, Diagram 1, Plate V, to form columns of THREES.—The player of the red writes on paper (Form 1), in red ink, the number of moves he demands, the movement he intends making, viz., form columns of threes. Leader reduces speed to 6 knots, wing ships increase speed to 9 knots, three moves. The umpire then records, in Form 2, red's time and moves demanded, and hands the signal to the assistant, who carries it into execution. The assistant-player, on reference to Table C according to rule, finds that the time this evolution will occupy is 5 m. 51 sec. ; he then refers to Table A, 5 m. 51 sec. at 9 knots = 1,750 yards.

To lay off this distance on the Playing-Board (Plate I), draw a line 1,750 yards in length from the position of the rear ship in the column, 282·8 yards to the right of her original course as in the Diagram

From Line Ahead to Columns of Divisions in Line Ahead.

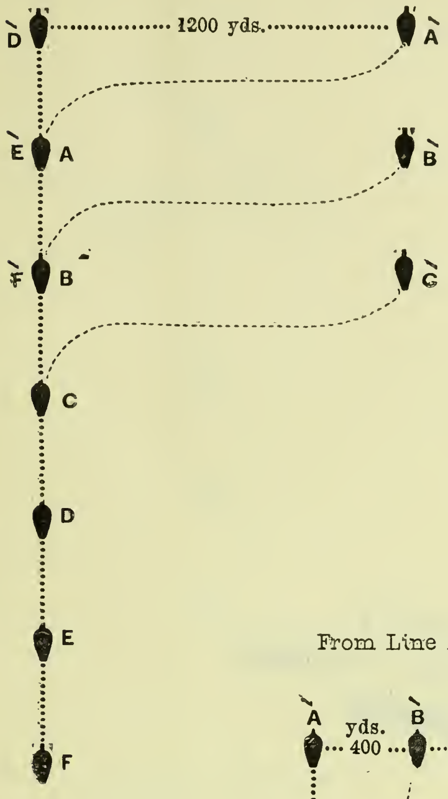


PLATE 4.

From Line Ahead to Line Abreast.

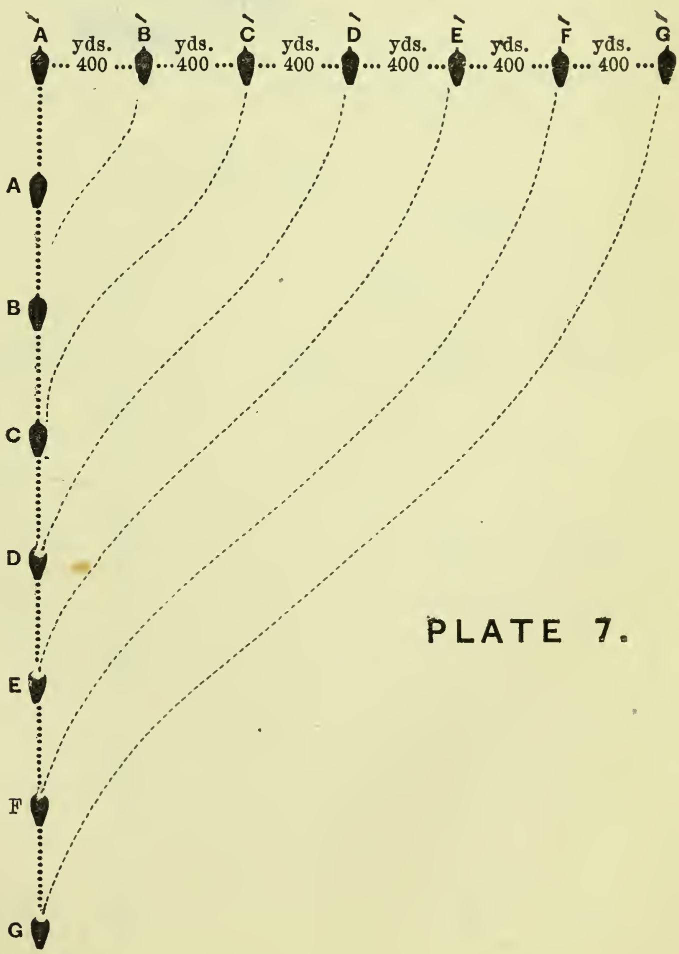


PLATE 7.

Columns of Three's from Line Ahead.

Groups from Line Ahead.

PLATE 5.

DIAGRAM 1.

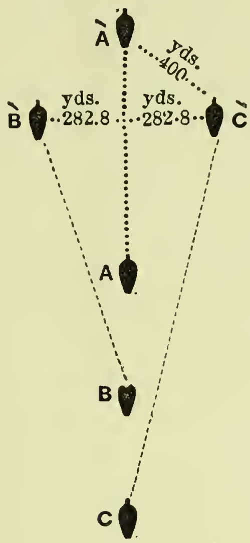
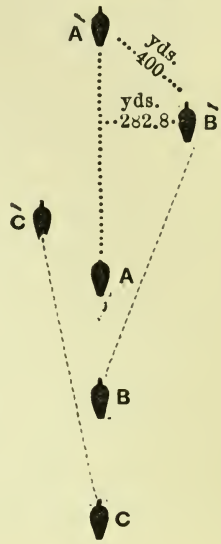


DIAGRAM 2.



From Columns in Line Ahead to Indented Line.

From Columns in Line Abreast to Indented Line.

PLATE 6.

DIAGRAM 1.

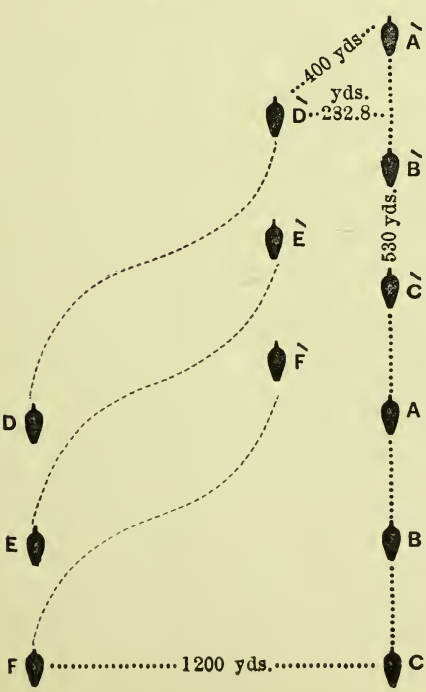
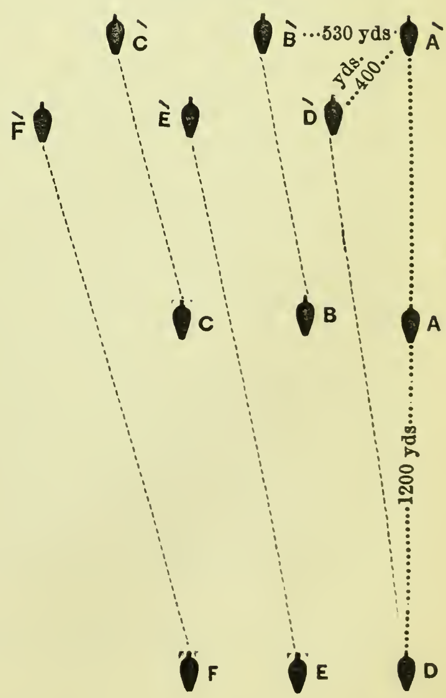


DIAGRAM 2,



1, Plate V. (`A) is the position of the leader, (`B) the left wing ship, (`C) the right wing ship. With a very little practice the assistant-player would learn to make these movements very quickly.

A few seconds will elapse after the completion of this movement before the time (three moves) claimed for it, has expired. If no move has been previously demanded, the columns of threes will continue to move on in the original direction.

The same rules are applicable for group formation (Diagram 2, Plate V), and therefore will not require any explanation.

The next formation provided for is FORMING THE INDENTED LINE, from DIVISIONS IN LINE AHEAD (Plate VI, diag. 1). Table E is constructed to facilitate this movement. Supposing the fleet to be moving at the speed of 6 knots, and either player wishes to form the indented line, the player gives the umpire the slip of paper (Form 1), stating his intention; this slip of paper is handed to the assistant player in the usual manner. Supposing the left division to have an excess of speed of 2 knots. Then on reference to Table E, it will be found that the least time in which this evolution can be performed, is 3·86 minutes; now lay off the new position of the leader of the right division, at 6 knots per hour during 3·86 minutes, and place the leader of the left division 400 yards distant and 4 points on the right leader's quarter; the remaining ships will be placed in their respective positions.

When reforming column in line ahead from this formation, Table E may again be used.

If, again, the fleet be in TWO COLUMNS IN LINE ABREAST (Plate VI, diag. 2), and it is wished TO FORM THE INDENTED LINE, the number of ships in each division being three, the player acts as before, the assistant player refers to Table F, and ascertains the time; for instance, leading division steaming 6 knots, the rear division has an excess of speed of 3 knots, their time by Table F = 9·19 minutes; lay off on the Board (Plate II) the distance at 6 knots during 9·19 minutes, and protract the positions of the remaining ships.

Again, suppose the fleet to be moving in SINGLE COLUMN in LINE AHEAD, and a broader front is required, for instance, to form SINGLE COLUMN in line ABREAST (Plate VII). This evolution will be expedited by the leading ship reducing her speed to steerage way, the remaining ships moving by the shortest road to their new front, when there take up the speed of the wing ship; when all are in line abreast they increase speed together. To ascertain the time and distance, refer to Table G for distance; enter Table A with the distance found and speed of the last ship, and you find the required time.

Having spoken of the evolutions which treat exclusively of changing formations, we next come to a series of evolutions such as changing directions of columns; columns of bow and quarter lines, &c. These evolutions I propose to treat much in the same manner as the before-mentioned ones; for this purpose, tables must be computed on the same principle as Tables C and D, and with a little ingenuity on the part of the assistant players, any of these movements may be plotted down on the playing-board.

Altering the course of columns, preserving the formation of the fleet,

either when in columns, in line ahead, or in line abreast, and preserving bearing and distance, present difficulties, which at present I have not endeavoured to overcome, but I imagine that should opportunity occur, the time for these evolutions at different speeds and with various numbers of ships, might be noted. These times would be generally useful in supplying data for this game.

With reference to "stationing," I do not think that it is necessary to enter into an explanation as, I take it, that such evolutions would not be attempted in the presence of an enemy.

In conclusion:—I wish to be thoroughly understood, that this game can never take the place of experience. I do not pretend that it will be useful, to those who are already experts in the art of manœuvring ships. I only hope that it may be useful to those, who have not had the great advantage of schooling in evolutionary squadrons, also to those who intend making naval tactics a portion of professional study.

There is one point that I am anxious to dwell upon. I believe that I am right in saying, that at present no facility whatever for the study of tactical formations is given by the authorities to the Officers in command of ships by furnishing them with the turning curves made by steam-ships on their trials. The turning curve of each ship should be tabulated and supplied to each vessel for the use of the Officers. Another point we are deficient in is the absence of an authorised "manual of naval tactics" which could be procured by Officers desirous of studying this important subject. We ought to have a tactical drill book similar to the Army Light Infantry Drill Book—a book procurable at the nearest stationer's shop. If a naval man has a taste for military manœuvres, he can study to his heart's content every branch of the "Land War Game," but there are no helps whatever in the study of Naval Tactics.

Perhaps I have laid myself open to censure in that I have not brought before you to-night, the method of performing all the movements given in the Evolutionary Signal-Book. Time has not permitted my entering into them all, but I have endeavoured to treat a portion of them thoroughly, in order that it may be seen that the remaining evolutions are susceptible of similar treatment.

In making these explanations, I am to a certain extent restricted from quoting the Evolutionary Signal-Book, but I sincerely hope that I have not trespassed on its "confidential" character.

I have only spoken of the elementary, but, I am inclined to think, most useful evolutions, avoiding questions of rams, guns, or towing torpedoes; for until this game is accepted in its simpler form, I think it would be unwise to introduce the consideration of various offensive arms, which would in their varied uses add fresh complications.

I feel sure that all present this evening, recognise the necessity of some such assistance in exact tactical studies as, under the name of a game, I have endeavoured to explain. Should the game only be studied occasionally by a few Officers, it will bring imaginary opposing squadrons into tactical contact with each other. This must raise discussion which will assist to fix the limits of practicable plans and

ideas in the heads of those who interest themselves in the science of naval evolutions and tactics.

General Formulæ by which the Results shown in the foregoing Tables C, D, E, and F, may be found.

In each case let a yds. = distance passed over by fastest ship in 1 min.
b = ,, ,, ,, slowest ,, ,,
and n = Nos. of minutes.

To Construct Table C.

$$a^2n^2 = 400^2 + (800 + nb)^2 - 2(800 + nb)400 \times \cos. 45^\circ$$
$$= 16000 + 640000 + n^2b^2 - 452480 + 565{\cdot}6\, bn$$
$$a^2n^2 = 347520 - 1034\, bn + n^2b^2$$
$$n^2 + \frac{b \times 1034}{a^2 - b^2} n = \frac{347520}{a^2 - b^2}$$
$$n^2 + \frac{b \times 1034}{(a - b)(a + b)} n = \frac{347520}{(a + b)(a - b)}$$

Equation for Table D.

$$n^2 - \frac{b \times 234{\cdot}4}{(a + b)(a - b)} n = \frac{93760}{(a + b)(a - b)}$$

Table E.

$$n^2 + \frac{b \times 566{\cdot}}{(a + b)(a - b)} n = \frac{920978}{(a + b)(a - b)}$$

Table F.

$$n^2 - \frac{b \times 1834{\cdot}4}{(a + b)(a - b)} n = \frac{921280}{(a + b)(a - b)}$$

Lieutenant Brown, R.N.: I should like to ask the lecturer, as no arms are used by the ships, what is the ultimate issue of the game as played between the two players according to the present rules, I mean, what influences the decision of the umpire with respect to the various ships and the ultimate issue of the game?

Lieutenant Castle: I am rather afraid that Lieutenant Brown has mistaken what I wished to convey to the meeting. What I have been working at for some time, is to show what I have shown you this evening. I have not attempted—nor do I intend to attempt, until I have worked through the whole of the Evolutionary Signal-Book and really fought this battle—to enter into the subject of the power of one ship against the other when fighting. There is one point that, before I come to actual contact, I should be glad to mention. I have taken average diameters, and average circles, average lengths of vessels, and average speeds. That is all very well indeed on the playing-board; but when we come to the disposition of the fleets with regard to each other, and there is no time to make signals, then, I think, the curves that I spoke of just now (the curves that I thought were so necessary to be supplied to each ship, of the turning powers of various vessels) may be used with very great advantage. It appears to me that the climax of what is to be done at present, is to bring the squadrons into contact with one another. We ought to have some pre-arranged plan, so that, if we attack in a formation, on

arriving within a certain distance, we should have some definite idea of the individual work of each ship. That will be the conclusion which, ultimately, we shall arrive at. Of course, there are several courses open. We may have several separate flags for separate movements. One flag would be the signal to engage, or to alter the course four points to starboard, or to port, or to pass through line, or on the right of the line, or on the left of the line. Whenever I have played this game, these are the points that we have always argued about. I have not the power at present of deciding which ship will have the advantage when in actual contact. One man would say, "My guns will penetrate your armour." Another will say, "My armour will "resist your guns;" and all this provokes discussion. I do not think, at the present moment, that I am prepared to discuss with anybody that portion of the game. At the same time, I think, it is very easy indeed for the umpire to decide which, in his opinion, has the best position at the commencement of the attack. You might leave it to him, at any rate, to say who is in the most favourable position.

Lieutenant BROWN: I meant it is the business of the umpire at the conclusion of the game to decide, when the two fleets are brought within a distance when no more signals can be made, which fleet is in the best position for attack. (Lieutenant CASTLE: That is my object.) The curves in Plate 3 have been calculated for an average length of 300 feet for each ship? (Lieutenant CASTLE: Yes.) Have the two extremes of the longest and shortest ships been tried to see what difference the length would make according to the scale on the chart on which you propose to work out the plan; have you always assumed that same average during the game?

Lieutenant CASTLE: Just so.

Lieutenant BROWN: Have you ever tried the game on the quarter scale?

Lieutenant CASTLE: No, I have not; and I do not put much faith in it. It might be necessary when you are within 200 yards of each other, and when you come to fight with individual ships; but otherwise I do not put much faith in it. It would only be necessary when you come to fighting individual vessels within 200 yards of each other.

Captain WHEATLEY, R.N.: Are the same tactics applied to vessels with end-on fire as for broadside fire?

Lieutenant CASTLE: I have merely taken the Signal Book as my basis to start from, working the fleet evolutions as they are given for our use, taking them for what they are worth. I thought it was the only way of playing my game.

Captain CODRINGTON, R.N.: Do you play the game irrespective of time, like the moves on a chess-board?

Lieutenant CASTLE: Time is the essential point of the game.

Captain CODRINGTON: Then the moves would be behind the signals?

Lieutenant CASTLE: Not exactly.

Captain CODRINGTON: I do not see how, in using these scales and manipulating the models of the ships on the board, you would actually put your fleet in the same position in the same time that a smart hand would hoist a signal?

Lieutenant CASTLE: I do not want to. When I have played my game, I have been two hours in thinking over moves that really occupied 38 minutes. There is no object in moving quickly. When you arrive at some formation, you consider what is to be done next; there is no hurry about it.

Commander ANSON, R.N.: My difficulty was with ships with double screws. Supposing you suddenly stopped or reversed your engines, or one engine or the other engine, it would be important to lay that down on the table.

Lieutenant CASTLE: I do not think double screws would have very much to do with it. You might reasonably, if you are steaming 10 knots, take 3 moves—6 minutes, or 4 moves—8 minutes in a general way. I do not think it would much affect the principle of my game.

Captain COLOMB, R.N.: I am unfortunate in having missed the reading of the paper; but I see at once that there are differences of opinion; and, out of these differences of opinion, we should always get a certain amount of truth. There is no question whatever that the endeavour must be a good one—whether it be well done or ill done—the endeavour is one of those things which is perfectly certain to produce other endeavours. The lecturer having taken it up seriously must have gone a certain length with it. Whether he has begun wrongly or rightly, I cannot say; but

the Officers present who heard the paper, and that very much larger number, including myself, who will hereafter read it carefully, are quite certain to get ideas which will carry them farther; either they will avoid what appear to them to be errors, or they will make advances in the other direction. When I met the lecturer at Portsmouth the other day, he spoke to me about the tables I see. They are quite irrespective of any game of the kind proposed, and the value of such tables is very great in all the movements of our fleets, in those which are proposed to be retained, and in those which are to be condemned; because the great element for their retention or condemnation, is the *time* occupied in performing them. Now, any single individual asked to pass judgment upon any of these different movements might not always have the means of so doing at his disposal; and the Lecturer having taken the trouble to go through the movements and to calculate, as he has done for different speeds, the amount of time that each movement would take, puts a great deal into the hands of naval Officers that they had not in their hands before—a great deal of excellent stuff that is very useful, and that can be applied at once. As to the general question of the War Game, my difficulty has been, that whereas in the Army what is a disadvantage and what is an advantage, is perfectly understood and known, and has been tried by the experiment of war, as far as the Navy is concerned, we are actually *in nubibus* as to what are advantages and disadvantages. Therefore, if the game is in the nature of the military war game, I cannot quite understand how it is to be decided which has won. In point of fact, whether you may not credit a man with having won—for doing something which further experiment and further consideration would show is just what he ought not to have done. I am bound however, to say, when I mentioned it to the Lecturer at Portsmouth, he told me that that point hardly entered into his proposal.

Captain Burgess: I should like to ask Lieutenant Castle how many games he has played, and whether the Officers who played them were generally satisfied?

Lieutenant Castle: I have played four games; and the general idea amongst my messmates was that we were a long time making our moves. We took two hours in our final game to get over a time of 38 minutes. Suddenly we brought our squadrons within 800 yards of each other; and then came the knotty point as to who had the advantage. A discussion followed. Instead of the Umpire giving a final decision, every one present argued the point for themselves. The result was, that the next day none of us were satisfied. This game provoked an immense deal of discussion—a thing that had seldom been provoked before. It provoked so much discussion that I think it really led to uncommonly good results, and it was ultimately decided by the Commander of ship, which fleet was in the best position.

The Chairman: The difficulty which has just been partly answered is the one that I feel. It is this: that after all these manœuvres I cannot see how it can be an easy task for the Umpire to decide who has the advantage. Whether they are 800 or 400 yards apart, the question as to the final decision is then to arise. It is a very different thing in the *Krieg-spiel* as played in the Army, because the whole thing is based upon very different data, and data that are so clear and so easily ascertainable with regard to the movements of troops over roads and over country, and so on. I must say, there seem to me almost insuperable difficulties in carrying this game out to an issue that will really be practically useful; but still, at the same time, it is quite evident that anything that turns the minds of Officers to think about tactics, and the time and the manner in which ships are to be moved, and that, in addition, has the advantage of these tables to which Captain Colomb has alluded, must be useful. I think, therefore, we are very much indebted to Lieutenant Castle for bringing this subject before us—a subject extremely novel to most of us; and I may say I am only expressing the sense of the meeting in returning him our thanks for having brought it forward. I may go further and say we trust that he and others who take an interest in this matter, will work it out, and, at some future time, bring the subject again before us in a more complete state. I cannot help feeling that, at present, we are only on the threshold of a very difficult and complicated question, which may, in the end, be extremely useful to the Naval Service in general. I, therefore, with your permission, will return our thanks to Lieutenant Castle.

EXTRACTS FROM A REPORT ON ORANGE WALK, NEW RIVER, AS A MILITARY POSITION FOR THE PROTECTION OF BRITISH INTERESTS IN HONDURAS; WITH NOTES AND EXPERIENCES ON OUT-POST DUTIES IN "THE BUSH."

Communicated by Lieut. J. E. Bale, 1st W. I. Regt., Garrison Adjutant, Jamaica.

Population.

This small settlement has a fluctuating population, may be from 300 or 400 inhabitants, on the average, the majority half-breeds, between the American Indians of the adjacent tribes and the descendants of Old Spain, long located on this portion of America, a few English artificers, or waifs and strays from over-crowded towns, who develop, from surrounding pressure and incidents, into useful hands, as carpenters, wheelwrights, smiths, and jobbing builders, &c.

Native Buildings.

The Indians are expert and ingenious in making their huts, or more properly, houses of hut materials, for they truss and frame their roofs on sound architectural principles, using only well-selected, naturally grown poles and timbers, which they bind or lash together with "tie tie," a strong fibrous parasite or vine, made pliable as rope by soaking in water; when dry, it keeps the whole firmly in position, and the roof is thatched with palms, using the stems of the leaf to hold it on the rafters and laths, in a complete and uniform manner. The butt of the principals is a natural fork, sometimes kept from splitting by interlaced "tie tie;" the walls are made of pimentos, small palm trunks, placed vertically side by side, and plastered with marl within and without. All the above they do without using a single nail or even a peg of wood. The floor is usually of marl, pounded down hard.

Water Transport.

The produce from the estates, also merchandise from Belize to the different stations, is conveyed by schooners or bongys (old Spanish bonga, a boat), along the river and the sea passage within the reefs and bays to Belize.

Road Communication.

Roads, so called, are, with the exception of short distances from or around a settlement, impracticable for carriage traffic, and the bridle roads are merely tracks through the primeval forest and across portions of lagoons, and quite impassable during a rainy period; the rains, however, are partial most of the year, so that no correct idea can be formed of roads at a distance, unless by traversing them often; a cart

road exists to Trial Farm, $1\frac{1}{2}$ miles north of Orange Walk, and another to Tower Hill estate, to the south about four miles.

Rivers—Lagoons.

The rivers are slow, even sluggish, very tortuous, frequently forming a letter S in a distance of half a mile, generally deep, with steep banks, or fringed with mangroves growing to a height of 30 to 50 feet for miles together; many savannahs open out from these rivers; lagoons are numerous, and many are of considerable extent, and are mostly impassable.

Climate.

The sun is as usually felt in the tropics, and in addition to its rays, there is a great glare of reflected light and heat from the marly ground, when not overgrown with grass and weeds. A great change of temperature takes place at night during the winter months, the thermometer sometimes registers as low as 58° or 59° during the prevalence of the "Northers."

If rain falls, or has lately fallen, the whole country is chill and damp, with dense vapours or fogs, which wet the clothes and hair, and chill the frames of people exposed at night, and especially so just before day dawn: these mists often last up to 10 or 11 o'clock, A.M., when they change, through the sun's power, to oppressive, hot vapour, till dispelled by evaporation.

Troops and Mercantile Influences and Results—Hardy Qualities of the Indians—Specialities of African Troops for Bush Service.

The mercantile and trading element at Belize has much influence, through the Members of Council, in ordering the disposal of the troops, a disposition seldom approved of by those in charge of stations for timber cutting, sugar estates, &c., who from past occurrences feel the insecurity of their position from the fact that when once the Indians cross the frontier, the Rio Hondo, they have made a successful invasion, and can march by various routes, skirting villages, and halt unperceived in the bush till opportunity offers to make an attack on any station, settlement, or estate; in fact they could pillage and destroy in detail many estates before military aid could be rendered, and an attempt at pursuit would be fruitless and disastrous, unless unusual accident favoured the pursuers. The Indians have a thorough knowledge of the bush tracks, a keen instinct for self-preservation, and from infancy are accustomed to hunt and travel through miles of country with but scanty provisions; being comparatively unincumbered, wearing merely linen cloth trousers and shirt, straw hat, and leather sandals or mocassins, with a gun, powder-horn, and shot-bag or valise, and a machee, they will far outmarch our West India soldiers, who are not in such training, although they cast off much of their cumbersome uniform and accoutrements, and possess considerable powers of endurance, and bear with impunity, apparently, malarious influences that would be highly detrimental to white troops. Their wants are few, they are generally inured to scarcity or irregularity in food, accustomed to prepare it

for themselves, and are expert foragers, even on the line of march if permitted; a few minutes after the halt, fires will be kindled and pots boiling, a pleasant cup of hot tea will be offered, produced from lemon grass and other wild herbs, and a palatable breakfast of simple materials, vegetables, roasted green corn in the ear, &c.; they one and all make excellent soup from their ration meat.

Geographical Position.

Orange Walk is about 40 miles up the New River, southward of Corozal, and N.W. by N. of Belize, about 70 miles by road or track through the bush, and 9 miles east of Albion Island on the Rio Hondo, which river runs approximately parallel to the New River, dividing British Honduras from the Indian territory of Yucatan.

It is a very deep sluggish stream with but three or four principal fords, *i.e.*, convenient places for landing when the river is crossed by dories, or pit-pans, for, like the New River, its banks are fringed for the most part with mangroves or thick bush, almost trackless, and in many parts impenetrable. The Rio Hondo is a strong natural barrier, and our first line of defence can be readily patrolled and watched by a small swift steamer. The key of this position is Albion Island, high land and of good extent, formed by the river diverging into two streams and meeting again.

Block-houses with a few men would guard the other fords, and these detachments might be often relieved and quickly reinforced by means of the small steamer. The depôt for fuel, &c., should be at Corozal, whence reinforcements could be obtained; small detachments (police) might be stationed at Orange Walk, being furnished from Albion Island and relieved by sections weekly, or oftener, thus affording the advantage of patrols to and fro, and keeping up communication between the frontier and the centre of the Northern District, as well as with Belize by the couriers mentioned herein under postal arrangements.

Description of Steam Vessel.

The vessel should have twin screws, so as to turn the quick bends of the river safely. She should have a commodious deck with shot-proof boiler-plate bulwarks, loopholed at certain parts for musketry, also a "dove-cot" (as they were called in the Southern States of America) at the main mast-head (the fore-mast must be clear for canvas) viz., a cylinder of boiler-plate loopholed, from which position sharp-shooters have a good command; the wheel amidships and within a house, with bullet-proof shutters, to be raised in action, having cruciform slits in them, to obtain sights through.

Armament.

Howitzers of large calibre for canister grape and shell, the latter most useful in searching out and dislodging an enemy in the bush; Hale's rockets also are especially serviceable for this purpose.

Site of Barracks at Orange Walk—Selected Site for new Barracks and Block Houses.

Assuming that the garrison is retained at Orange Walk, the present site of the barracks is bad, in a position forbidden to be taken up when occupying a village; they are situated at the re-entering bend of the river, leaving fully three-quarters of the position defenceless, commanded by the adjacent ground and hemmed in by the houses; the bush growing up to and even among many of these houses, sheltered the approach of the Indians, and accounts for the sudden surprise of the garrison; steps have, however, recently been taken for building barracks on a suitable site, defencible themselves, and affording covering protection to the town and settlement; these, with the addition of block-houses on each flank, for the safety of the outposts stationed there, will completely protect the village, for the Indians dread water and never use canoes on the rivers for armed excursions; the local canoes, therefore, dories, or pit-pans being secured, the river forms a secure barrier to the position around which it partially winds.

Precautions on taking up a position in a wild, hostile Country—Check Patrol and its advantages—Precautions to prevent Observation by an Enemy—Check Patrols useful in obtaining Reports and Information.

In taking up or defending a position in a hostile or threatened district, safety mainly depends upon the frequency of patrols and the unobstrusive vigilance of sentries; every patrol should be conducted after the rules laid down for advanced or rear-guards, and additional precaution should be taken to transmit to, and receive communication from, the main body. This would generally be merely an outpost in itself, furnishing an inlying and outlying picquet, with a chain of sentries furnished from the latter, the guard sentries serving as connecting links between them and the outposts. The small number of men available, and the encumbered nature rather than the extent of the ground to be covered, renders the double chain of sentries impracticable for a number of consecutive days; but similar, and almost equal advantage, may be obtained by making the single sentries do their own patrolling between post and post; this is ensured by the following simple expedient of "patrol-checks" (as instituted by Lieutenant Bale, whilst on a tour of out-post duty at Orange Walk, just after the late raid of the 1st September). Say the picquet sentries are out, and the guard sentries (1 and 2) in their ordinary positions; if it is considered desirable to send the check round between reliefs, the Officer on duty or the non-commissioned Officer of the guard takes a "patrol-check" (which may be an oblong piece of wood, lettered P, with a number or letter on it) and accompanied by a file of the guard, goes to any sentry's post he wishes to start it from, say No. 6, and gives it him to carry to No. 5, and 5 to 4, and so on. One of the guard is left to hold No. 6 post, till the "return-patrol" reaches him, this is another check—a bit of wood of different shape, say wedge-shaped, having R P, and a number corresponding to that on the patrol-check, on it—carried by the non-commissioned Officer to No. 1 sentry, who

after receiving the "patrol-check" and ascertaining that all is correct, gives up the "return-patrol;" the latter is then passed back along the chain of sentries, each man resuming his original post, till No. 6 gives it to the guard man at his own post, who takes it back to the guard-room, and the time of its absence is noted by the non-commissioned Officer. This effectually prevents any laxity or irregularity on the different posts, and any observations made by a sentry are communicated for information; the men themselves like the system as varying the monotony; it cheers them to meet a comrade and exchange "all's well" at the other posts, and often trivial scraps of news are God-sends during a period of anxious solitude; it, moreover, keeps the men on the alert without becoming irksome. At night the sentries are instructed to patrol alongside fences and on the grass, avoiding the bare light-coloured ground, and whilst on their posts to stand under the shade of trees or against any dark object, from which they cannot be distinguished at even a few yards distance. The great coat is put on loose over belts and accoutrements, and the sling removed from the rifle, otherwise a white pipeclayed strap will at once reveal the whereabouts of a sentry. The pass or countersign is varied according to instructions from the Officer on duty, and may be a low whistle, two soft taps on the butt of the rifle with the palm of the hand, or any decided but not conspicuously loud challenge. The rounds on duty can at once verify the statement or conjecture of any sentry, as reported to the non-commissioned Officer of the guard, by proceeding direct to the post in question, or if the "check" or "return" is an unusually long time in passing round the chain or *cordon* of sentries, the non-commissioned Officer and a file of the guard patrol to ascertain the cause of delay.

In case of a change in the posts of the sentries being decided on, the non-commissioned Officers of outlying and inlying picquets are assembled and instructed, that they may afterwards explain their orders to the men, and if deemed necessary the men are posted for a short time during daylight, that they may know, and take up their positions without confusion if suddenly ordered out. In case of alarm, the picquet sentries are doubled. After the outlying picquet parades at the guard, or the rendezvous, they proceed direct to their respective posts, and as soon as sufficient time has elapsed, the check is sent round to ascertain if they are at their posts and all correct.

Officers Instructing Men during a Tour of Duty—Cover and Sentries—Shelter from Rain.

It is of great advantage to both the Officer and soldiers if, when the former visits the sentries on their posts he encourages them to give their opinions in addition to answering questions; many valuable suggestions are thus obtained, for no one can know the specialities of a post better than the sentry who has done duty on it a few times; it further encourages the men to make intelligent observation of what is around them, and they feel that the Officers have an interested share in their duties. So with the non-commissioned Officers and men

accompanying an Officer whilst patrolling, admirable opportunities are afforded of illustrating the best way of proceeding unobserved, and acquiring information, if at night or dusk passing along by dark objects and under the shadows of trees, or if the ground is cleared keeping to the hollows, and when stopping to listen, getting beside a tree stem, or down on the grass by a bush. It also tests the vigilance of the sentries, who, if they are Africans, will be faithful to their trust; and if their instructions are to fire if their challenge is not answered, the patrol will be fired into if they do not keep their ears open. A limit of distance for each sentry to patrol on his post is advisable, according to the nature of the cover afforded, and at night they soon learn to conceal themselves effectually. By daylight all advanced sentries should be protected by a temporary cover, concealed by a little growing bush, and be provided with waterproof sheeting, one to lie on and one to cover themselves with in wet weather; all other sentries should have assigned places for shelter, in the event of a heavy downfall of rain, or the percentage of sick from fever and ague would soon make a great deduction from the effective strength of a small outpost force.

Silence and Secrecy Essential—Mounted Men as Patrols—Signalling not Available.

Secrecy in all outpost arrangements is essential, particularly when the natives are disaffected, and may act as spies, and the fewer loud words of command, and especially bugle calls that are heard, the better. The picquet sentries may be recalled during the day by visual signals, passed from post to post, and at night by sending the check round to recall them; they then come in direct from their posts, and no conspicuous signs of movement are apparent.

Cavalry are practically inoperative for the ordinary manœuvres of that arm, but as scouts and patrols, mounted men are invaluable: mounted Zouaves were occasionally employed as such, till His Excellency, Lieutenant Governor Cairns, entrusted the Colonial Secretary, Captain Mitchell R.M.L.I. with the formation of a body of mounted police, to be stationed at Orange Walk; they are commanded by a Sergeant of Constabulary, who speaks Spanish and the Mayor languages; he is a good disciplinarian, and his duty is to receive orders from and report to the local magistrate, who is the Commander of the outpost. Although the force consists of only 12 men, and the Sergeant, they have greatly relieved the burden of Military duties, and established a sense of comparative security, from the regularity with which they bring intelligence from the Fords on the Hondo and the villages, &c., of the frontier. From the generally level and densely wooded nature of the country, semaphore signalling is not available for any considerable distance; the natives signal by firing "Bombas," a charge of powder in any kind of vessel, perhaps a hollow gourd, wrapped or quilted over with cordage or grass fibres, and fired by a slow match, which makes a loud report; these, however, when used by allies to warn the garrison, afforded no intelligence, but caused general and groundless alarm in the neighbourhood.

Indian Drill and Formation of Companies.

Drill adapted to bush work. The Indians have taught us a practical lesson in this respect. Their companies formed in single rank are only twenty-four men, led by a Captain, who has subdivision leaders in the ranks. They usually march in Indian file, one behind the other, through the bush paths, never with a greater front than two abreast, and if they form into line it is only preliminary to a rapid deployment.

Field Exercises and Advantage of adopting Indian Drill—Judicious Tactics of Indians.

In West India regiments, ten men per company are trained and paid as gunners. This number will serve a howitzer. The half companies may be formed as separate companies in single rank, in charge of the guides, and the words of command in present use may serve for precisely similar formations to the Indian drill. This small force then becomes capable of covering a good extent of ground, and is flexible to a degree, but the Captain should be mounted to keep it well in hand; it is capable of counter-manœuvring the Indians by their own tactics, but is backed by a concentrative power unpossessed by them and has the support of artillery fire. The complete surprise of the garrison by the Indians and their orderly retreat after their long but abortive attack, are well known, but since this, particulars of their invasion and march on Orange Walk have transpired, which prove it to have been a well-planned and masterly-executed affair. Their ammunition was neatly manufactured, and the supply of rations of corn cake (unfermented) was sufficient for a week's supply to each man. They secured beforehand a number of pit-pans or dories on the Yucatan side of the Hondo, to effect a simultaneous crossing, and their most advanced files were two miles to the front. They passed all information to the advanced guard as well as persons they met with on their route, who were then transferred as prisoners to the custody of the rear guard, unless they had arms and volunteered to join the main body. This force carefully skirted all villages and plantations, and came unsuspectedly to the rear of the village of Orange Walk, and behind an outlying empty hut, within 100 yards of the magistrate's house. At this place there was all the appearance of an advanced party having bivouacked for some hours during the night. There is no doubt of the supineness or even treachery of the native inhabitants of Orange Walk; and no doubt that the Indians are a subtle and by no means contemptible enemy to deal with.

Earth-work Defences.

The barrack has been protected by earth-works, defended by two pieces of artillery, as far as its defective position will permit, by the Officer commanding the outpost.

Commissariat.

The Commissariat Department is efficient and in harmonious working order.

LECTURE.

Friday, April 18, 1873.

Admiral Sir GEORGE BACK, D.C.L., F.R.S., Vice-President, in the Chair.

THE VOYAGE OF H.M.S. "CHALLENGER."

By William B. Carpenter, Esq., M.D., LL.D., F.R.S., &c., &c.

About six years ago, my friend, Professor Wyville Thomson, then Professor of Natural History in Queen's College, Belfast, wrote to me that he had received from Professor Sars, of Christiania, intelligence that his son, the Superintendent of Fisheries to the Government of Sweden, had dredged up from a depth of about 300 fathoms, near the Lofoden Islands, an animal of remarkable interest, being a small Crinoid which represented—not the larger crinoids at present known to us as inhabiting West Indian seas, but the fossil form, known to us as the *pear encrinite* of the Bradford clay. You have here a large representation of this creature, the pear encrinite; of the actual size of which you may judge when I tell you that its body is about the size of a small pear. It is a fossil extremely common in the Bradford clay, a member of the great Oolitic formation in Wiltshire. The little specimen dredged up by Mr. Sars is figured here; and you may judge of its size from the fact that I have within this bottle two imperfect specimens which are about the size of large carpet pins, the body being about the size of the head of the pin. On a careful examination of the structure of these specimens, which were afterwards sent over to Professor Wyville Thomson, we quite accorded (having made a special study of this group) in the identification of this specimen as corresponding with this remarkable type, which had been supposed to be long extinct; the only representative of it in any later formation being a Crinoid of the Chalk, which had been only found in one place in the Island of Martinique, and was not known to have existed elsewhere. Here, then, was a fact of very singular interest. In the first place, to find any true Crinoid living on a stalk, attached throughout its whole life, within the seas of Europe, was in itself a novelty of no small account; because up to that time we had known no true stalked crinoid as an European animal. The beautiful *Comatula*, or feather-star, which is an inhabitant of the shores of Great Britain, as well as of many other localities, is a crinoid in its essential

structure; but though a stalked animal in its early period, it drops off the stalk at a certain stage of its development, and from that time lives as a free-swimming form. Here, however, we have, within Europe, a true Crinoid, remaining stalked throughout the whole of its life. But the greatest feature of interest was this: Here, living at a considerable depth in the sea—300 fathoms—was an animal of a type which had been supposed to be long extinct; and its discovery would lead to the surmise that there might be a great many more animals supposed to be extinct, living still in the deeper recesses of the ocean, not having been subjected to those changes of climate, of food, and other conditions which affect to a very much greater degree the animals living near the surface. Then again, supposing this little Crinoid to be the legitimate descendant of that larger one, but to have been dwarfed—perhaps by depression of temperature, perhaps by deficiency of food—supposing it to be, according to the modern view, the actual hereditary descendant of the old pear-encrinite, here was a curious fact, that from that time to this, there had been animals inhabiting the deeper recesses of the ocean, of which no one had known anything, their remains having been neither discovered in the examination of fossilised deposits, nor their living forms met with in any exploration of the existing ocean.

This made us feel that it was a matter of very great scientific importance that such Deep-Sea explorations should be extensively prosecuted; and we agreed that it might be worth while to endeavour to move the Royal Society to make application to the Government, for a vessel which should be fitted for the purposes of deep-sea exploration, the limit to which up to that time had been about 400 fathoms. It had been generally supposed, up to that date, that no life existed at greater depths, excepting those very low types—the minute little *foraminifera*, of which you have here representations; such as the little *globigerinæ*, covering the floor of the Atlantic, which had been brought up by the sounding-lead from great depths. In fact, scarcely any dredging had gone down even to the depth of 300 fathoms. The principal part of the knowledge of the animal life existing even at that depth, had been obtained by a sort of large sounding apparatus; but we considered that any efficient exploration must be done by means of the dredge, and that it was desirable to carry this down to very much greater depths. Of course there were mechanical difficulties in the way; but we thought that these might be overcome, and that, at any rate, it was worth while to attempt to carry down dredging to 600, or 800, and possibly 1,200 fathoms. We made application through the Royal Society, the Council of which readily took up our proposal, to the Government in the year 1868. The Government readily fell in with our views, and assigned to us a vessel of some historical interest—the "Lightning"—one of the first pair of steamers built for the Government service in the year 1825, an old paddle-steamer, which had been latterly employed in the Surveying Service on the Coast of England. We desired to find the deepest water which we could easily reach from the shores of Great Britain; and from the soundings which had been previously taken, we learned that this lay in the channel between the North of Scotland and the Faroe Islands. You see, by

this map, the general situation of this channel, which I venture to call the "Lightning" Channel, because it will be a region of some historical interest hereafter. The white portion of the map is the sea-bottom within the 100-fathom line, lying to the north and north-west of the North of Scotland, and also on the Faroe Banks. Between those two dotted lines in the coloured portion of the map, there is a depth ranging from 100 fathoms down to between 500 and 600, and in some parts even over 600. There is no such deep water as this to be met with so near our shores in any other part.

You are all aware, I suppose, that between Great Britain and the coast of Scandinavia, of Sweden and Norway, and of Denmark and Holland, and again to the south, Belgium and France, there is no water 100 fathoms deep. If the whole of our corner of Europe were raised up not much more than the height of St. Paul's, we should be united almost continuously with the continent of Europe, and Great Britain would be united with Ireland. Of course the Isle of Wight and the Isle of Man would be all taken in, and there would be a considerable extension of the land to the west of Ireland. Here, however, at the north of Scotland it would make very little difference, except that the Orkney and Shetland Islands would be united to the main land. There would still be a deep channel between the north of Scotland and the Faroe Islands. Well, we devoted ourselves, in spite of very bad weather, to the exploration of this channel by means of the dredge; and we also did the best we could in an inquiry, to which it was thought some interest might attach—the temperature of the sea at that depth. Now, at that time the general doctrine was that the temperature of the sea at any considerable depth was uniform all over the globe. That doctrine was partly based on the temperature-soundings taken in Sir James Ross's Antartic Expedition, and partly on other temperature-soundings, which seemed to agree with them. Sir John Herschel had adopted it, and had given it currency, in his very valuable Treatise on Physical Geography; and in this country the authority of Sir John Herschel gave that statement such weight, that no one thought of questioning it. Still it was thought that some good might accrue from making careful observations; and we went out provided with the best thermometers we could obtain. We very soon found remarkable and unexpected results; and to these I will first direct your attention. We found, in some of our soundings, at a depth of 500 or more fathoms, a bottom temperature of 33°. In other instances, we found on the very same bottom, at the very same depth, and perhaps within 20 miles, a temperature of 45°. Now, what was the meaning of this? It occurred to me that it must mean that there are two currents; one from the north-east, bringing down a polar temperature; and one from the south-west, bringing up a temperature warmer than the normal of the latitude,—for as that latitude was 60°, the normal temperature of that latitude would be below 39° at the surface, still more therefore at any considerable depth. We carried out this investigation much more fully the next year; and we were then provided with thermometers that could be relied upon. For having been led to suspect that even the very best thermometers—the

thermometers of the Admiralty pattern, manufactured by Mr. Casella—were not to be trusted at pressures even so moderate as these (for we are accustomed now to consider 500 fathoms as quite shallow water), we caused experiments to be carried on by Mr. Casella, by placing these thermometers in a hydrostatic press, and subjecting them—not to the pressure between two boards, such as goods are pressed between in packing—but the pressure of water, which would press equally all round. They were put, in fact, into the interior of the hydrostatic press, and subjected to a pressure ranging up to three tons on a square inch. The pressure of a column of water of 800 fathoms depth is just about one ton on the square inch; so that the pressure of 2,400 fathoms (and we have passed that depth in our temperature soundings) is equal to three tons on the square inch, the utmost pressure the hydrostatic press would afford. It was found that the very best of the Admiralty thermometers under this pressure went up 8° or 10°; and that thermometers of other makers, not so well constructed, went up 20°, 30°, 40° or 50°. So that you see it was at once shown that all the old observations taken at any considerable depths were utterly untrustworthy, and that the only use we could make of observations taken with them was by correcting them for the *minimum* of error. For example, if Sir James Ross obtained 39° at a depth of (we will say) 2,000 fathoms, we should be quite sure that his thermometers were wrong at least 7° or 8° at that depth; and that the real temperature which the thermometers ought to have indicated, was about 31° or 32°. Our own first year's observations were not invalidated to anything like that degree, because they had not been taken at any depth greater than 530 fathoms, except 650 in one instance; and, at any rate, I felt sure on returning from that first expedition, that the observations made with the ordinary thermometers were good to this extent—that they correctly showed the *difference* of submarine climates; because here, on the very same bottom, and within 20 miles of one another, were temperatures so different as 33° and 45°; so that, whether the real temperatures were or were not lower, the difference between them would still be the same. The late Professor William Allen Miller devised a means of protecting the bulb of the thermometer, which simply consists in enclosing it in an outer bulb that acts as a sort of buffer, and takes off from the inner bulb the pressure on the outer; the space between the two being about three-fourths filled with spirit. These protected thermometers are all subjected to the severest test in the hydrostatic press; and the pressure of even three tons to the square inch has scarcely any influence in sending up the liquid. They may be regarded as registering, in the most trustworthy manner, within a degree; and where two thermometers are employed together, I believe we may rest with the most complete assurance on that agreement.

We found, then, on taking *serial* soundings—that is, sending down the thermometer repeatedly at gradational depths, or sending down several thermometers attached to the sounding line at different points, so as to be able to take the temperature at 50, 100, 150 fathoms, and so on, so as to be able to obtain the temperature of different strata at

the same time in the same spot—that there was distinct evidence in "the cold area" of two strata of water, an upper stratum of water warmer than the normal of the latitude, and an under stratum of water very much colder; and thus my previous suspicion of the existence of a double current was completely confirmed. You will see that the surface temperature is the same in both these sections, that the temperature goes down in the first 100 fathoms very nearly at the same rate in both; but below 150 fathoms the temperature very rapidly decreases in one, while it changes but little in the other. Every line in that diagram represents one degree of temperature; and you see how the lines are crowded together between 200 and 300 fathoms, that being the depth at which the great change takes place in what I call the "stratum of intermixture" between the one and the other. Below 300 fathoms we come into a stratum of water more than icy cold; for with these improved thermometers we could register the temperature exactly, and that temperature we found to go down to 29½°. You will ask me why the water did not freeze at that temperature. Salt water does not freeze at the same temperature that fresh water does; and salt water contracts continuously to its freezing point, so that it becomes heavier as it becomes colder. That is a very important fact, which (as you will immediately see) has an essential bearing on the general doctrine of oceanic circulation. Fresh water, as I presume you all know, ceases to contract in cooling when it reaches 39°, and it then begins to expand again, so that at 32° the water is as bulky (and therefore as light) as water at 46° or 47°. But sea water continues to contract down to its freezing point at 27° or 28°, or even 25° if kept very still, becoming less and less in bulk down to that degree, so that it is at its least bulk and greatest density just before it freezes. That is a point to which I shall have presently to return.

We found then that the Animal Life of these two areas differed just as much as the Temperature; and I will now direct your attention to a few of the forms of interest which we obtained in our first expedition on that area.

This very beautiful Siliceous Sponge was one of our most fortunate captures. It came up just on the borders of the warm area, in the midst of the mud, partly mixed with sand—the globigerina mud, of which you have a specimen in this bottle, which exactly corresponds with this that was obtained from three miles' depth in the Atlantic —a substance corresponding in all essential particulars with Chalk. The great interest attaching to this siliceous sponge was, in the first place, its being an entirely new type of a group to which attention has been of late very considerably directed: the group of siliceous sponges, with one form of which you are all, I doubt not, familiar, the very beautiful *Euplectella*, or Venus's flower-basket. The special interest of our *Holtenia* to geologists, is that it very closely represents the Ventriculites, a large group of fossils extremely abundant in our Chalk. I happened to be speaking of this in going over Lewes Downs at the time of the meeting of the British Association at Brighton, and a gentleman present said, "Oh, yes, when I was a boy I used to collect "ventriculites in the chalk pit of this very hill in any quantity." It

was peculiarly interesting to find a representative type of this class of fossils of the old chalk, in this new chalk now in process of formation; and I think I may say that it was the discovery of this specimen which procured for us all the facilities subsequently afforded us for the prosecution of our researches, and that it has really been the foundation of the "Challenger" expedition; for the interest which it excited amongst naturalists and paleontologists was such as at once to make the Council of the Royal Society feel that the inquiry ought to be thoroughly carried out.

We met with a great many other specimens of great interest, and amongst them these little *Rhizocrini*, corresponding with Professor Sars's Crinoid, at points remote from each other, showing that they must be very extensively diffused.

We were able in our second Expedition—that of the "Porcupine," commanded by Staff Captain Calver—to carry down our dredging to the depth of 2,435 fathoms, and that dredging brought up $1\frac{1}{2}$ cwt. of Atlantic mud, with a large number of animals of different kinds, representing all the great groups of marine animal life, and amongst others, these two specimens of the little Rhizocrinus. They unfortunately want their arms, which, I suspect, were carried off in the trailing along the ground during the operation of dredging. There came up also a great number of extremely curious forms of Foraminifera, which constitute so large a proportion of the animal life of the sea bed, that I think I may say without hesitation, that this mass of Foraminiferal life, chiefly composed of Globigerinæ, at present covering the floor of the Atlantic, far surpasses the whole Terrestrial life of the present time. The floor of the North Atlantic over every part which has been sounded, excepting in some few places where the Arctic drift seems to be brought down by special under-currents, is covered entirely with this globigerina mud to a depth of which I have no knowledge whatever. I can only say that in one place we brought up half a ton of it from a depth of 700 fathoms; and at the great depth I previously mentioned, 2,400 fathoms, the dredge brought up $1\frac{1}{2}$ cwt. The surface of this is alive, and all that lies below the surface is the remaining product of animal life.

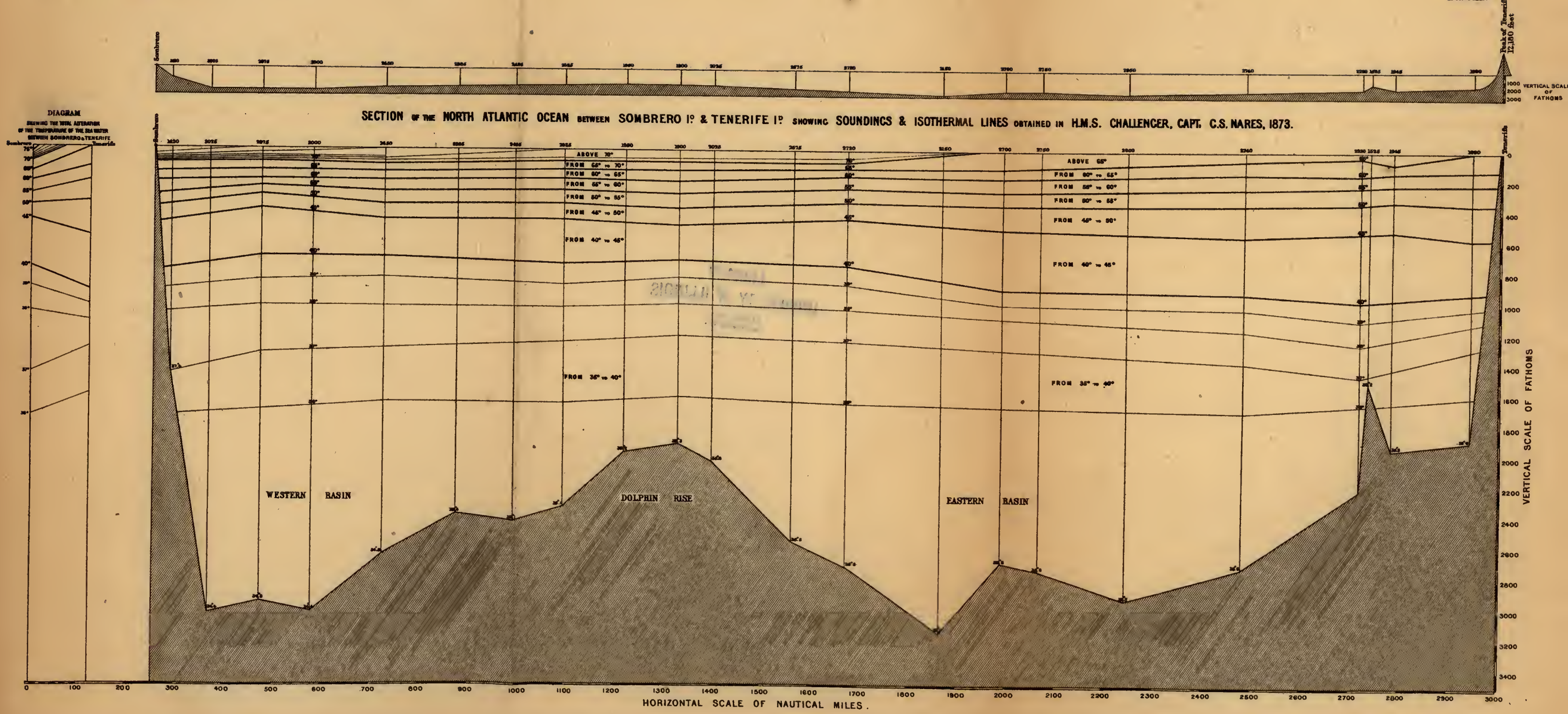
Time will only permit me to give you a summary of the general condition of things which we found in the bed of the deep sea. We brought up a very considerable number of animals representing forms which formerly existed, but were believed to be extinct. Among the large number of shells dredged up in the immediate neighbourhood of Great Britain, the number new to the British Fauna was more than one-fourth of the whole number previously known as British, and a great many of them new to science altogether, requiring many new genera and a great number of new species to be created. The greatest interest, however, was in the number supposed to be extinct, but found to be still living at the bottom of the sea. Then we found a great number of types of star-fish and sea-eggs of various kinds, belonging to the Cretaceous formation; some of them most curiously bringing down to the present time the plans of structure typical of the Echinoderms of the chalk. We found the distribution of animal life pre-

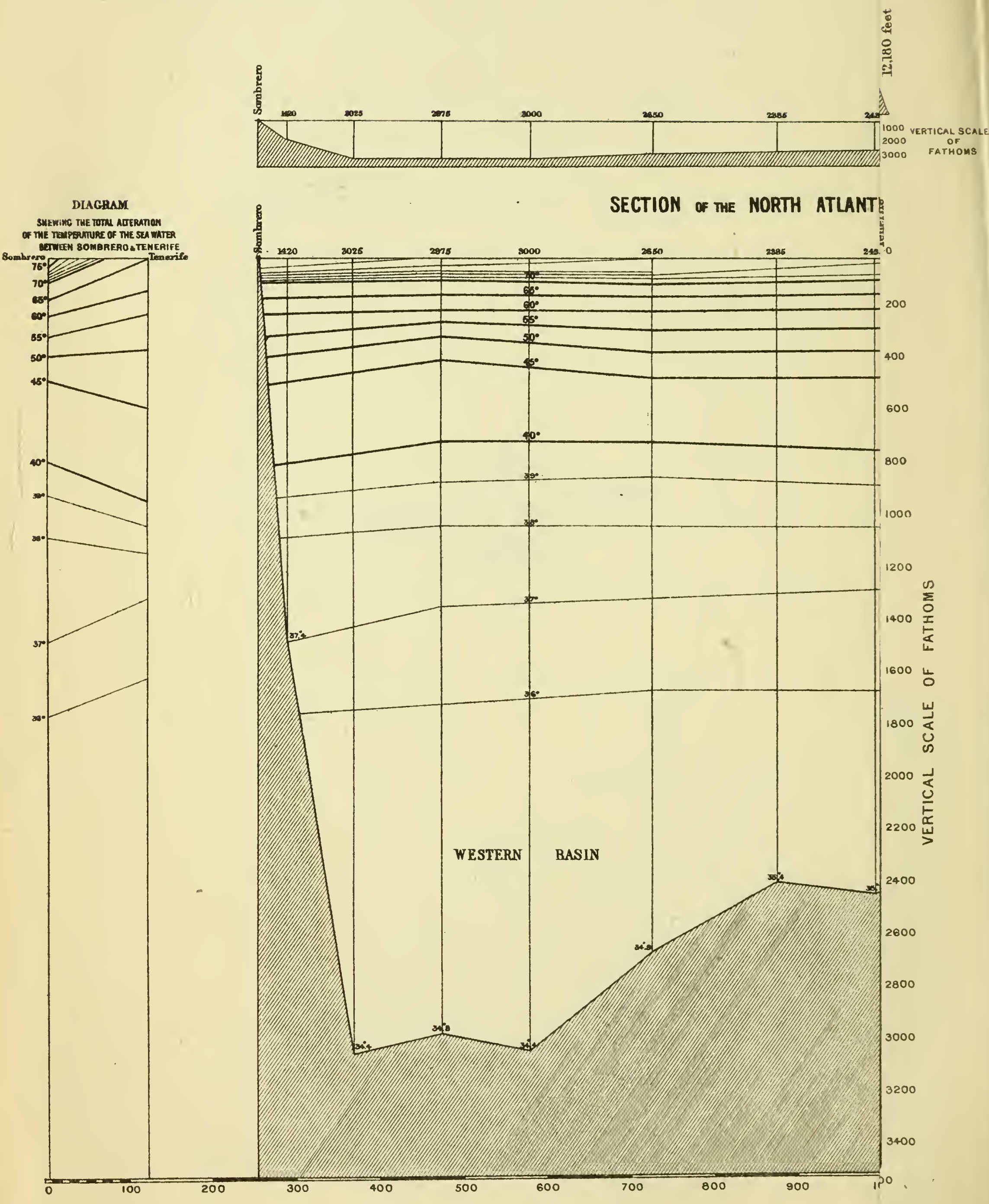
senting a very marked difference, according to the Temperature, on bottoms within a few miles of each other. The animals of the cold area were for the most part quite distinct from those of the warm area; though some were found everywhere. These sea-eggs (*cidaris*), which belong to a species previously rare, we found anywhere and at any depth or temperature. We found the same in the Mediterranean, between 100 and 200 fathoms, as we had found at considerable depths in the North. Here again are very curious crustaceans,—slender-legged creatures, like spiders, with scarcely any body—all legs—some of them extending six or eight inches across; these we found both in cold and in warm areas. But, as a general rule, the shells and Echinoderms and Foraminifera and Sponges were very different. I could not detect a single globigerina in the cold area, as they seemed to be entirely limited by the temperature. On the other hand, in the cold area we had a large and most beautiful Sponge, of quite a new type, which seemed to cover the cold area everywhere; and, I believe, furnishes food to the higher animals living in the cold area, very much as the globigerinæ furnish food to animals living in the warm area. We ourselves may really be said to feed on globigerinæ. I will tell you the sequence. We feed on cod. Supposing cod are brought, for example, from the Faroe Banks; these cod feed upon a kind of star fish, for the star fish are found in the stomachs of the cod; and then when we examine the stomachs of the star fish, we find that they feed upon globigerinæ; so that, to the extent to which we depend upon cod for our food, we may be said to depend upon these globigerinæ. I might follow the same line of inquiry a little further. What do the globigerinæ feed on? and there we are stopped by a very great difficulty. The solution of this problem I believe to have been afforded by the suggestion of Professor Wyville Thomson, that the globigerinæ really absorb liquid protoplasm diffused throughout the entire mass of sea-water—the sea-water being in fact a very dilute protoplasm, or very watery soup. This we find fully confirmed by the analyses that Professor Frankland was kind enough to make, of the samples of water which we brought him;—investigations of which, I have no doubt, will be carried on with samples supplied from every part of the great ocean-basins of the globe.

I must not say anything more with regard to the animal life, except in pointing your attention to these curious specimens. Here are some small star fish, not more than two inches across, which we dredged up in the cold area. They are the common "five-fingers" of our own coast, which range to the diameter of a dinner-plate. Our ordinary large 12-rayed star fish, which I have seen certainly 8 inches across, are represented in the cold area by these specimens not larger than a crown piece, which are clearly dwarfed by the low temperature. It is a matter of peculiar interest to see how such low temperatures affect forms with which we are perfectly familiar; because then we get the clue to the same influence operating through very long periods of time in reducing such a form as the Pear-encrinite to such a form as this little Rhizocrinus. This now lives in a cold bottom; but it is probable that the bottom on which it originally lived was much warmer.

Temperature and abundance of food would both have a very important influence; and the reduction of both would, in the progress of ages, be an adequate *vera causa* for the reduction of the older form to the present type. I may mention, that in a later cruize we obtained an extremely interesting example of a type of crinoids, which we knew to be still existing—the West Indian *Pentacrinus*. We brought up 20 specimens of it off the coast of Portugal, from a depth of between 800 and 900 fathoms. This is a very interesting fact, because it is a type of crinoids of which you will see abundance in the lias of Lyme Regis and elsewhere; and its presence has been supposed to indicate a warm temperature and a shallow bottom. But we found this living at a temperature of about 48°, and on a bottom of between 800 and 900 fathoms. These researches, therefore, tend very greatly to correct geological theory; by supplying a large body of new facts, which very often to a certain degree disturb our existing notions, but which also give us an entirely new and more secure basis for the construction of our doctrines.

Now, let me return to one of the great objects of interest connected with these explorations, the movement of water as indicated by its temperature. We have, as it were, a sort of epitome of that which I believe to be going on in the great ocean-basins, presented to us in the region we have examined. In taking temperature-soundings on the Atlantic Coast, from the Faroe Islands as far south as the Strait of Gibraltar, we found evidence of a very low temperature in the Atlantic, below about 1,000 fathoms. At about 1,000 fathoms we meet with 39°; then going still deeper, with 38°, 37°, and 36½°, at 2,435 fathoms. Off the Coast of Lisbon we found just the same "stratum of intermixture," between 800 and 1,000 fathoms, that we got in the cold area between 200 and 300 fathoms; for there was a sudden change from 49° to 40°, a reduction of 9° of temperature in about 200 fathoms. That seems to me a very significant fact, and particularly so when we take into account the contrast between the temperature of the Atlantic basin and the temperature of the Mediterranean inside the Straits of Gibraltar. The deeper part of the Mediterranean basin, which goes down to 2,000 fathoms between Malta and Crete, may be said to be completely separated from the Atlantic basin; for there is a ridge across the western *embouchure* of the Strait, of which a large part is within 100 fathoms, while its deepest part is 200 fathoms; so that this great Mediterranean basin is entirely cut off, as regards all below 200 fathoms, from the great basin of the Atlantic. That being so, what do we find? In the Mediterranean, from 200 fathoms to the bottom, at any depth, *the temperature is uniform.* The surface-stratum is superheated in the summer to 80°; and at 100 fathoms that superheating influence is almost entirely lost, so that the thermometer goes down to 56° or 54°; and whatever it is at 100 fathoms, that it is down to the very bottom. On the other hand, in the outside Atlantic, you will see somewhat the same superheating effect down to 100 fathoms, the thermometers falling from 68 to 53; then a very slow descent; but then at 800 fathoms a sudden fall, and the whole below 1,000 fathoms we know to be below 40°, going down to about 36°. I am able to show you the first fruit of the


SECTION OF THE NORTH ATLANTIC OCEAN BETWEEN SOMBRERO I? & TENERIFE I? SHOWING SOUNDINGS & ISOTHERMAL LINES OBTAINED IN H.M.S. CHALLENGER, CAPT. C.S. NARES, 1873.
DIAGRAM
Sombrero
Tenerife
Peak of Tenerife 12,180 feet
VERTICAL SCALE OF FATHOMS
ABOVE 70°
FROM 65° TO 70°
FROM 60° TO 65°
FROM 55° TO 60°
FROM 50° TO 55°
FROM 45° TO 50°
FROM 40° TO 45°
FROM 35° TO 40°
ABOVE 65°
WESTERN BASIN
DOLPHIN RISE
EASTERN BASIN
HORIZONTAL SCALE OF NAUTICAL MILES.


SECTION OF THE NORTH ATLANT
DIAGRAM
SHEWING THE TOTAL ALTERATION OF THE TEMPERATURE OF THE SEA WATER BETWEEN SOMBRERO & TENERIFE
Sombrero
Tenerife
12,180 feet
1000 2000 3000 VERTICAL SCALE OF FATHOMS
1420
3025
2875
3000
2650
2385
WESTERN BASIN
VERTICAL SCALE OF FATHOMS
0 200 400 600 800 1000 1200 1400 1600 1800 2000 2200 2400 2600 2800 3000 3200 3400
0 100 200 300 400 500 600 700 800 900

exploration of the "Challenger," kindly lent me by Admiral Richards.* This is a Temperature-section taken across the Atlantic, from the Peak of Teneriffe to St. Thomas's. You will see here the different strata distinguished by lines of equal temperature; in the upper part at intervals of 5°, in the lower part at intervals of 1°. It is at a depth of about 900 fathoms, exactly as my own soundings had led me to believe, that this line of 40° is to be found; and every one of these lines below indicates a degree of temperature; the whole mass of water below 1,600 fathoms does not exceed 36°, and the thermometer goes down at certain points to 34°; so that you will see that these cold bands of temperature which have been occasionally encountered by former explorers, were not mere little local currents, but —as I ventured to predict would prove to be the case—indicated the temperature of the whole mass of water in the Atlantic. On the western side of the Atlantic it is about a degree lower than it is upon the eastern side; and I rather suspect that this has reference to the cold Arctic current which comes down from Greenland and Labrador, along the eastern seaboard of the United States. The greatest depth which has been obtained is, I think, 3,100 fathoms; but it had not the lowest temperature. Its temperature was $35\frac{1}{2}$°.

The view of Ocean-circulation which I have been led to promulgate, on the basis of the facts which we obtained, is one which is not new. Though I was not aware of it at the time I put it forward, it had been promulgated by the great French physicist, Pouillet, more than 30 years ago; but it was subsequently put aside for the doctrine which had been espoused by Herschel. Pouillet said, "The facts at present "known to us lead to the surmise that on the one hand there is a con-"tinual movement of water from the Polar areas towards the Equator, "at the bottom of the sea; and, on the other hand, a continual move-"ment of the surface-water from the Equatorial area towards the Polar "areas." He did not give any precise indication of the forces which would keep up this movement; but any physicist will readily understand that there would be likely to be such a movement, when once the fact is taken into account that sea water continues to contract as it is cooled down to its freezing point, and does not expand again, as fresh water does. It was in working out that simple principle, that I was led to what appears to me a very definite notion on the subject, which is simply this:—Supposing you have a long trough (and this I exhibited experimentally three years ago at the Royal Institution, and two years ago at the Geographical Society) with glass sides, filled with water; at one end we wedge in between the glass sides a lump of ice; at the other end we carry heat from a spirit lamp, by means of a metallic plate, not to the bottom, but to the surface of the water. That would represent the condition of things in the Polar and Equatorial areas; in the Polar area, the continual action of atmospheric cold; in the equatorial area, the action of solar heat upon the surface. We found, by putting in some colouring liquid, that a continuous circulation was set up; the water

* The sectional diagram of depths and temperatures here given, is from one of a series being prepared by the Hydrographic Department of the Admiralty, and is inserted by permission of Admiral Richards, the Hydrographer.—Ed.

was drawn towards the Polar end, and, when it came into contact with the piece of ice, tumbled down as it were to the bottom, then slowly crept along the bottom to the opposite end, and there rose gradually to the surface under the heated plate of metal, and was then drawn on again towards the Polar area. So long as any ice continued at one end, and the heating action of the lamp continued at the other, so long the circulation continued, the one influence antagonising the other. The sudden and complete fall to the bottom of the water which came in contact with the ice, is simply the result of the increase of its density by the reduction of its temperature. Supposing there were two columns of the same height but of different densities, the column of greater density, that is the colder column, has a greater pressure not merely downwards, but laterally; therefore it flows out laterally, and as it flows out, it lowers the level, and more water is drawn in to replace it. Then as surface-water is drawn from the Equatorial area to the Pole, the bottom-water of the equatorial area will be continually rising upwards, being pushed up by the colder water which comes in below it; and in this manner there is maintained (I venture to affirm) a constant oceanic circulation, by a force just the converse of that which produces the circulation in our hothouses. In our hothouses and public buildings, we heat water; that water becomes light, ascends, goes through the pipes, becomes chilled, and comes in at the bottom of the boiler, being then heavier, and as long, therefore, as there is heat applied to the bottom of the boiler, and cold applied to the pipes in the building, so as to cool the water previously heated, keeping up the difference of temperature between boiler and pipes, so long there will be a continual movement. In the case of the oceanic circulation, the prime moving force is not heat at the bottom, but cold at the top. Heat sends the water up, because it is lighter; the cold at the top sends it down, the water is heavier. This is perfectly easy to conceive, and I can only say I am exceedingly surprised at the opposition this doctrine has met with. It was entirely accepted by Sir John Herschel, in a letter to myself, only a month before his death; it has been entirely accepted by Sir William Thomson, the greatest living authority in this country upon all subjects connected with the theory of Heat; and it is entirely accepted also by the President of the Royal Society. I therefore venture to put it before you with some confidence.

Now the working-out of this theory is one of the great objects of the work of the "Challenger." It was a point specially put before the First Lord of the Admiralty, when the first representations were made to him on the subject of a Scientific Circumnavigation Expedition, that there should be a careful temperature-exploration made of the great Oceanic basins. In the first place, the "Challenger" has gone across to Teneriffe, and she then goes to St. Thomas's. She returns from St. Thomas's in the line of the Gulf Stream towards New York, touching at Bermuda; then she comes back again to the Azores; and thus will take two sections across the Atlantic, one about 20° further north than the other. We hope that it may be possible to obtain in the neighbourhood of the Azores mechanical evidence of the under-movement of the deep stratum. I do not think that it should be called a "current." I

never believed it was anything more than a "creeping flow" (just like that which I was able to exhibit in the experiment), of, it might be, 6 or 8 miles a-day. And there is very curious evidence that there is such a flow. The first Atlantic cable of 1865 was buoyed with a long wire rope in about 1,900 fathoms deep, and to that rope was attached a buoy floating at the surface. It was hoped, when the "Great Eastern" went out the next year, that the buoy might still be found attached to the cable, and that the cable might be picked up by its means. That hope was disappointed; the buoy was not found, it had got adrift; but it was afterwards ascertained that the buoy had been seen by one of our West India mail steam ships, at a distance considerably to the south-west of the point at which it had got adrift. Now it was in the line of the Gulf Stream; how, therefore, could it drift to the south-west? The drift must have been from 6 to 8 miles a-day, supposing it had got adrift very soon after it was attached. The only explanation I can see would be, that this great under-stratum (beneath the line of 40°, perhaps beneath 43° or even 45°) is a mass of water slowly moving from the Pole towards the Equator. You will see, therefore, that a cord hanging down in this deep stratum would present a much larger resisting surface than the upper part of the cord and the buoy itself. Therefore supposing that there are two movements of water in the opposite direction, the much greater hold will be upon the lower part, and that would be an adequate cause for the drifting of the buoy south-west. The "Challenger" has lately obtained evidence in certain parts of the Atlantic, which seems to justify the belief that there is such a movement, though they have not obtained direct mechanical proof. They find that, instead of the bottom being uniformly covered with this Atlantic ooze, there are parts where it is rocky, and where the dredge is fouled; and from a letter which I saw a few days ago, I gather that Captain Nares is of opinion that there must be a movement of water over the bottom; that it has not that stillness which has been usually assigned to it; but that the water must be in a state of flow so as to keep some of the prominent parts bare. I do not know on what part this observation was made, but it may have been about this rise (pointing to the diagram), which seems to separate the area of the Atlantic between the Azores and America into two basins.

In the instructions given for the "Challenger's" work, I threw out a suggestion that the experiments for the mechanical determination of this current in the neighbourhood of the Azores might be effectual; that mechanical determination being made in this manner. I was engaged with Captain Nares, and previously with Captain Calver, in the investigation of the under-current of the Strait of Gibraltar, and we used there a "current drag." It has two pairs of large vertical wings, fixed at right angles to each other, so as always to present an expanded vertical surface to the water, and to be caught by any current that may lay hold of it when floating it from a buoy on the surface. By making due allowance for the strain of any surface-current upon the buoy, which is a matter of very great importance in working out observations of this kind, we found that there was not much difficulty in determining the existence of an under-current in those straits at a

depth of from 200 to 300 or 400 fathoms; but it has yet to be seen whether it will be possible to work such a current-drag at a depth of 1,000 or 1,200 fathoms. Captain Nares, I believe, is very sanguine of success in doing so. This current-drag was worked with very complete success by the "Shearwater" last autumn in the Straits of Dardanelles; and Captain Wharton there proved the correctness of the prediction I had ventured to make, upon theoretical grounds, that in the Straits of Dardanelles there would be found an under-current going inwards beneath the surface-current which runs outwards, in consequence of the difference of density—produced not by difference of temperature, but by difference of salinity—the specific gravity of Black Sea water being kept down to much less than that of the Ægean or the Mediterranean, by the excess of fresh water that flows into it above the evaporation. There is a similar inward under-current in the Baltic Sound, carrying back salt into the Baltic Sea, as in this case into the Black Sea. On the other hand, in the Strait of Gibraltar, the under-current is outwards, the surface-current being inwards, the conditions being exactly the converse; for the water of the Mediterranean is heavier than that of the Atlantic, the evaporation being greater in amount than the fresh water it receives. The consequence is, that the column of Mediterranean water is heavier than the column of the Atlantic water, and therefore presses outwards. In the Dardanelles, and in the Baltic Sound, the outside water is the heavier, and presses inwards.

Now I will take up the route of the "Challenger" to show the objects contemplated in her work. She will, I hope, be able, on returning to the Azores, to make the mechanical experiments which I have suggested; as I believe it to be there, coming down between Iceland and Greenland, that the greatest stream of cold water is to be met with —the cold water that reduces the temperature of the great basin of the North Atlantic. You must not suppose from the look of an ordinary chart, that the channels of communication between the Arctic basin and the North Atlantic are nearly as wide as they seem. You know that in a Mercator's chart all these northern distances are very greatly exaggerated; and the passage between Iceland and Greenland is really a narrow one. Between Iceland and the Faroe Islands, there is no deep water at all; for there is a bank of about 200 fathoms, which keeps all the cold water back. Between the Faroe Islands and the north of Scotland, there is a channel of 500 or 600 fathoms; and there, as I have shown you, there is a cold stream, great in itself, but nothing in comparison with the enormous area of the North Atlantic. I believe we shall find that, putting aside the North Pacific, the North Atlantic has the highest bottom temperature of the great oceans; for cold as it is, coming down in one place to $34\frac{1}{2}°$, I believe we shall find all the southern oceans colder still. The "Challenger" will then go on dredging and sounding all the way from the Azores, pretty nearly due south, keeping midway between the two great continents, and traversing the deepest part of the ocean as far as the equator; and she will then, after approaching the coast of Africa, cross towards South America, taking another section of the Atlantic just under the equator. This will be very important for comparison of the temperatures taken

under the equator, with the temperatures taken along the two northern sections. I have every reason to believe that under the equator we shall find it colder than it is found farther north; for between Sumatra and Ceylon, Commander Chimmo has met with a temperature of 32° at a depth of 2,500 fathoms, within five degrees of the equator. I believe the same will be found here, and why? Because you see there is an uninterrupted access of Polar water all the way from the South Pole. Whilst the North Atlantic basin receives only some tributaries of Arctic water, there is a great, broad, uninterrupted flow from the whole Antarctic area into the great southern oceans.

Having touched at Brazil and Rio Janeiro, the "Challenger" will then go across to the Cape of Good Hope, taking another section across the South Atlantic. Having passed the Cape, they will run to Kerguelen's Land, in the summer of the southern hemisphere—that is, next January. They will thence take a section, by going due south, or as nearly due south as may be, towards the great ice barrier; running as close to it in fine summer weather as may be considered expedient, and thereby taking a series of temperature sections, which will show us, not as here, the bands running nearly straight across, but what I believe will be an inclined plane. The temperature of 40° will then be found at the surface; and all the lower temperatures will come much nearer the surface than they do in this cross section. That examination of the temperature is one great object of this part of the expedition; and at the same time, the exploration of the animal life of these southern areas, as to which nothing whatever has been done, beyond one or two little scrapes at 400 fathoms taken by Sir James Ross, and a few specimens obtained by the sounding line. Returning thence, the "Challenger" will proceed to Sydney, and will, I suppose, remain there some little time for repairs, refitting, and rest. Then on starting from Sydney again, she will cross to New Zealand, and take a southern turn there; for there are a great many matters of very great zoological interest which it will be desirable carefully to examine. A good deal is known of the marine fauna of New Zealand, and what is known, leads us to the belief that there will be much to repay further research. In the Indian Archipelago, to which the "Challenger" will afterwards proceed, the ups and downs of the bottom are very extraordinary. By the kindness of Admiral Richards, I have had particulars of the temperature-soundings sent home by Commander Chimmo; and it is curious to see the enormous depths sometimes met with in the neighbourhood of land. For instance, in the Celebes Sea, one of the deepest soundings was obtained that had ever been taken, about 2,800 fathoms. And I may mention that in all these soundings the temperatures correspond exactly with what we should expect when we consider what access the Polar water has to the particular locality. For example, here, as I mentioned, between Sumatra and Ceylon there is free access of Polar water; aud the bottom temperature is reduced to 32°. In the Celebes Sea, that access is made circuitous by the land; but still the thermometer goes down to 38°. In the Zulu Sea, the temperature resembles that of the Mediterranean; for it goes

down rapidly at the surface and then stops at 50°, and down to 1,600 or 1,700 fathoms it is still 50°. The reason of this is to be found in the fact, that this little sea, though not enclosed on the surface more than very partially, is shut in below by continuous reefs, forming a sort of crater or cup; and within that crater the temperature is constant, just as it is in the Mediterranean. There is probably no more interesting region in the world for zoological and for temperature exploration, than this Eastern Archipelago; and we anticipate from it the richest harvest of results of both kinds.

The "Challenger" will go round the Phillippine Islands, New Guinea, the Solomon Islands, and will then pass northwards along the line of the warm current, which there takes the place of the Gulf Stream current in the Atlantic. This warm current is simply the result of the equatorial Pacific current driving onwards until it meets the land, and then turned by it to the north, just as the Atlantic equatorial is turned by it to the north-east. From Japan, the "Challenger" will go across the Pacific to Vancouver's Island, taking temperature soundings and dredgings the whole way. This is an entirely unexplored bottom. I said just now that I ventured to predict that the bottom temperature in the North Pacific would be found higher than that of any other ocean, and why? Because it has no communication whatever, as regards deep cold water, with the north Polar basin. You all know, of course, that the only communication of the North Pacific with the Polar basin is by Behring's Straits, which is not only a narrow but a shallow channel, having no more than 20 fathoms of water. Through that shallow channel no cold water can come down, and therefore Behring's Straits is practically a coast line to the cold water of the Polar Basin. Any cooling of the bottom of the North Pacific, therefore, will depend upon water that comes all the way from the South Pole; just as the cooling of this area between Aden and Bombay to 35° or 36° depends on water that has crossed the Equator. I quite expect to find that the temperature of the Pacific, even as far north as Columbia, may be reduced to 36° or thereabouts; but I do not think it can be colder than the North Atlantic, and I should expect to find it a degree or two warmer, in consequence of having no communication with the Arctic basin. (I believe that the cooling of this great mass of water in the North Atlantic must be due fully as much to water that has come from the South Atlantic as to the North Polar water, so small are the streams that can come even from the North Polar basin.)

The "Challenger" will then stretch out into the deep portion of the Pacific, keeping at a considerable distance from the coast till it is necessary to put in for supplies; and carrying on the same series of explorations in the eastern portion of the Pacific, as previously on the other side. We suggested that she should run out rather further, if time allows, into the middle of the Pacific, taking a longer loop than is here laid down. Then the same series of inquiries will be carried on round Cape Horn and on the eastern side of South America.

This is a general sketch of the work which she has to do; the purpose being, in the first place, the thorough and complete Physical examination of the Ocean as regards depth, the temperature at all depths, in

all strata, the surface temperature, the currents, the movements of the surface by wind and other causes, the deep movement, the composition of the water in different parts, the specific gravity, the proportion of saline constituents, and especially of the gases, which have a most important influence on the distribution of animal life, and the question of the universal presence of organic matter, which is one of the most interesting points of all. Dr. Frankland was quite astonished at the amount of this in the samples of water which we brought home, taken at some 200 or 300 miles' distance from land, and at a depth of several hundred fathoms. The question will be to find whether the presence of organic matter is equally conspicuous in water from the great oceanic basins, as it was in our small corner. Then, of course, the examination of the Animal Life from all depths and in all parts where it may be found feasible to carry on these explorations, will be a leading object. There are certain bottoms, near land especially, which are very rocky, and where it is very difficult to work the dredge with success; and there, probably, it may not be possible to obtain all that would be desired. But still we have means, even there, of getting samples of great value; and I may just mention that one of the most important additions we made to our dredging apparatus was a sweeping apparatus, the bottom being not only scraped by the dredge, but swept by hempen tangles like swabs. (It does not answer, however, to employ *used* swabs; we had to make them for the purpose, because it is only when freshly made, the adhesiveness of the fibre still remaining, that the swabs are effective.) These tangles were most wonderfully effective, not so much for bringing up shells, as for bringing up echinoderms and all kinds of crustaceans, corals, &c., that they laid hold of. I may give you, as an example of their extraordinary effectiveness, this circumstance, that in dredging near the Shetland Islands, our tangles came up loaded with one species of sea-egg, about the size of the top of my finger. This species had been previously known by ones and twos. There were, perhaps, half-a-dozen specimens of it in museums, not more. Our tangles came up, on a moderate estimate, loaded with 50,000 of them. Here are some that were cut off and put into this bottle exactly as they were laid hold of by the hempen tangles. I suppose there are fifty specimens in this bottle, and these were nothing to the mass we brought up. Again, our tangles came up over the cold area, laden with this beautiful comatula, which we had previously only known through specimens costing five guineas a-piece, brought from Iceland and Greenland.

I have thus endeavoured, as fully as our limited time will allow, to place before you a general idea of what the work of the "Challenger" is. It is to carry out in these great ocean basins the kind of exploration which we had found effective in the short investigations which we had had the opportunity of engaging in; thanks to the constant assistance of the Government, and particularly I must say to the unwearied kindness of Admiral Richards, who was always ready to promote our views; and thanks, I must also say, to the liberality of the Chancellor of the Exchequer, who, from the very first, took a very great interest in this inquiry, and to whom I went, before moving the Admiralty on the

subject of the "Challenger." I first secured the cordial concurrence of the Chancellor of the Exchequer, who told me that anything the Admiralty considered to be proper in this matter, would meet with his entire support. I have felt it right on all occasions to state this, because I believe the principle on which the Chancellor of the Exchequer proceeds in these matters is the right one. I do not say it may be always rightly applied, but I believe the principle is right, that what private enterprise can well do, private enterprise should be left to do; but what only a Government can do for the promotion of science, by its organization, by its means and appliances of various kinds, the State should do. On that principle Mr. Lowe has acted consistently, with regard to the three successive applications which we made for carrying on our previous work, with regard to two Eclipse expeditions, and with regard to this, the greatest of all, the "Challenger" expedition. With respect to any further propositions for Arctic research, or the like, it is not that he considers they are wrong in principle, but it is simply a question of policy as to whether it should be carried out. It is due to Government to make these statements, because nothing could have been more liberal and effective in every way than the fitting out of the "Challenger" expedition. Everything the Royal Society could ask for has been liberally done, and I venture to hope that the results of this research will be such as to present what will be universally felt to be an adequate return for the expenditure of mental power and of money involved in its preparation and execution.

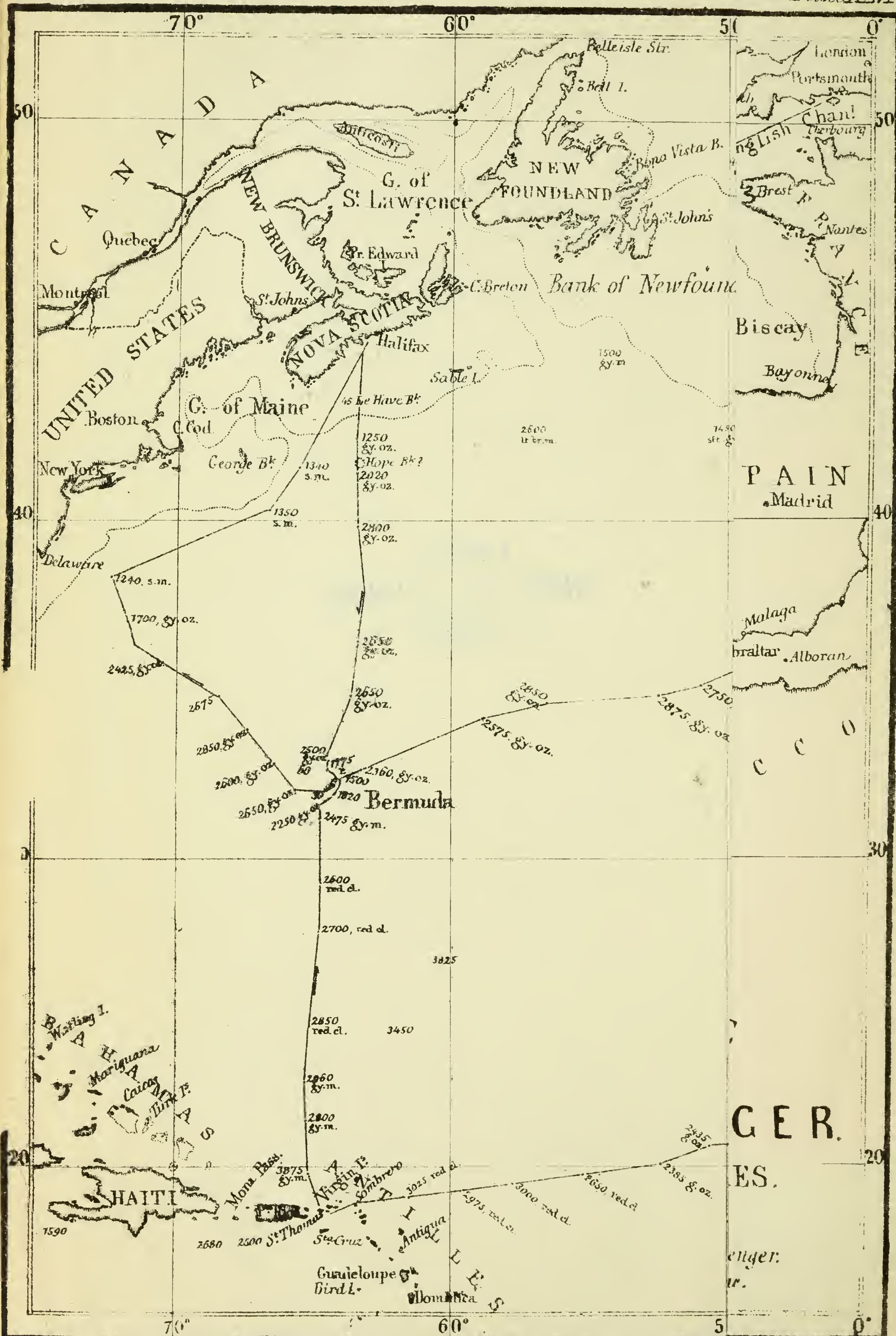
The Chairman: It is impossible for any one to have listened to this most interesting lecture of Dr. Carpenter's without perceiving the amount of scientific knowledge and of rare analysis which he has brought to bear upon it. His elaborate report to the Royal Society last year on the scientific researches of the vessels just mentioned, and more especially his own vast labours, must be studied to be appreciated as they deserve. And now that he has had the goodness to foreshadow what may be reasonably expected from the work of Professor Thomson and his excellent staff on board the "Challenger," I am sure I only anticipate your wishes by giving expression to the thanks that are due to him for his very interesting lecture.

EXTRACT FROM A PAPER READ AT THE "BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE," AT BRADFORD, BY CAPTAIN J. E. DAVIS, R.N., ON "THE SCIENTIFIC VOYAGE OF THE CHALLENGER."

(Appended at the request of Dr. Carpenter.)

The "Challenger" has now accomplished a natural division of her important voyage, as she has passed out of the North Atlantic into the South. From England she went to Lisbon, Gibraltar, Madeira, and Teneriffe. From the Canary Islands to Sombrero and St. Thomas'.


VOYAGE
OF
H. M.S SHIP
CHALLENGER.
CAPT. G. S. NARES.
1873.
Track of the Challenger.
100 Fathom Line.
CANADA
UNITED STATES
NEW BRUNSWICK
NOVA SCOTIA
NEW FOUNDLAND
G. of St. Lawrence
Bank of Newfoundland
Flemish Cap
G. of Maine
Quebec
Montreal
Boston
New York
Delaware
Halifax
St. Johns
C. Breton
Sable I.
Bermuda
AZORES
Flores
Graciosa
Terceira
S. Miguel
Pta. Delgada
Formigas
Sta. Maria
Fayal
Pico
Chaucer
Josephine Bk.
Madeira
Funchal
Dezertas
CANARIES
Salvages
Tenerife
S. Cruz
Palma
Ferro
Gran Canaria
Fuerteventura
C. Juby
C. Bojador
South C. Blanco
CAPE DE VERDE ISL.
S. Antonio
St. Vincent
Fogo
SPAIN
Madrid
PORTUGAL
Lisbon
Oporto
St. Vincent
C. Finisterre
C. Ortegal
Coruña
Vigo B.
Cadiz
Malaga
Gibraltar
Alboran
B. of Biscay
Bayonne
FRANCE
Brest
Nantes
Cherbourg
English Chan.
London
Portsmouth
Plymouth
Scilly
C. Clear
Cork
MAROCCO
Mogador
N. C. Blanco
HAITI
BAHAMAS
St. Thomas
Sombrero
Antigua
Guadeloupe
Dominica
Bird I.
St. Cruz
70°
60°
50°
40°
30°
20°
10°
0°


CANADA
UNITED STATES
NEW BRUNSWICK
NOVA SCOTIA
NEW FOUNDLAND
G. of St Lawrence
Quebec
Montreal
Boston
C. Cod
New York
Delaware
G. of Maine
George Bk
St Johns
Halifax
Sable I.
Le Have Bk
Pr. Edward I.
C. Breton
Anticosti
Belleisle Str.
Bell I.
Bona Vista B.
St John's
Bank of Newfoun
Bermuda
Biscay
Bayonne
Brest
Nantes
London
Portsmouth
Cherbourg
PAIN
Madrid
Malaga
braltar
Alboran
HAITI
Mona Pass.
Virgin Is
Sombrero
St Thomas
Sta Cruz
Antigua
Guadeloupe
Bird I.
Dominica
Watling I.
Mariguana
Caicos
Turk Is
GER.
ES.
enger.
1350 s.m.
1240. s.m.
1700, gy. oz.
2425, gy. oz.
2850 gy. oz.
2600, gy. oz.
2650, gy. oz.
2250 gy. oz.
2475 gy. m.
2600 red cl.
2700, red cl.
2850 red cl.
3825
3450
3875 gy. m.
2575. gy. oz.
2875 gy. oz.
2360, gy. oz.
3025 red cl.
3000 red cl.
2650, red cl.
2385 gy. oz.
1250 gy. oz.
2020 gy. oz.
1500 gy. m.
2600
1590
2680
2500

From St. Thomas to Bermuda, then across the Gulf Stream towards New York and to Halifax. From Nova Scotia back to Bermuda, and then across the ocean to the Azores, and from the Azores to Madeira and Cape Verde islands, from which place the last accounts were received. My remarks, therefore, will be confined to that division.

The labours of the voyage may well be considered dualistic, viz., those of the natural science department and that pertaining to hydrography. I shall confine myself to the labours of Captain Nares and his nautical and hydrographic staff, leaving those of Professor Wyville Thomson and his natural science staff to others more conversant with the subject than myself; and although admitting the vast scope of the Professor's labours, I claim for the one branch equal importance with the other, for it is obvious to the most casual thinker, that the skill (which may be considered a branch of practical science in itself) required in getting a correct depth of the ocean at 3, 4, and 5 miles, to dredge or trawl in equal depths, to obtain a complete series of temperatures at different depths, fixing positions, measuring meridian distances, and other hydrographical work—and this apart from the usual toil of the navigator and seaman—is no ordinary manual labour; and if the mass of ooze brought up by the dredge would, from want of knowledge of natural history, be useless to this branch of the expedition, it is equally clear that the deepest knowledge of natural history lore would be similarly useless without the skill that brings the "grist to their mill;" therefore I think I am quite correct in claiming equal importance for the two divisions of work.

The "Challenger" sailed from Portsmouth on the 21st December, and on her passage down channel and across the Bay of Biscay, encountered the weather very generally met with at that season of the year; however, it settled things down and shook everything into its place, and fortunately, as sounding was impracticable, the ground over which they passed had been previously examined, so there was no loss of time.

The first deep sounding in 1,125 fathoms off, but to the southward of, Cape Finisterre was not very successful, for the line parted when heaving in, and a thermometer was lost; nor was the first attempt at dredging more so; the dredge certainly came up, but bottom up, so the result was *nil.* The second trial proved more successful, and some bright-coloured star fishes and other animals were brought to light. Another attempt at dredging was made in nearly 2,000 fathoms, but whether it fouled the Gibraltar and Lisbon cable or a rock, it mattered little, for after trying seven hours to extricate it, the rope broke and the dredge was lost.

The "Challenger" reached Lisbon on the 3rd January. The King of Portugal visited the ship, and the ship sailed on the 12th.

One part of the duty in deep sounding is to ascertain the true depth of the ocean, and another part to remove bad or doubtful soundings and *vigias.* A *vigia*, a word from the Spanish, is a reported danger in mid-ocean. A piece of wreck with the sea breaking over it, a vessel bottom up, or even a patch of weed, has often been reported as a rock by some captain, seen by him, perhaps, through fog or in thick

weather, and it takes its place on the chart; once there, it remains sometimes for years, to the terror of the navigator, until a few casts from a deep sounder in the vicinity, and a careful look out in passing and repassing the supposed danger, causes it to be expunged from the charts. In respect to doubtful soundings, the difficulty is greater, as may be imagined. On leaving Lisbon, the "Challenger" sounded in the vicinity of two of these doubtful soundings, two rocks of 370 and 423 fathoms, and obtained 1,270 fathoms near them, and 1,380 between them; and although the presumption is that they do not exist, still from what I shall have to remark as I go on, it would be almost presumption to assert it, and an instance occurred the next day to bear me out in this, as in dredging off Cape St. Vincent, where the dredge was let down in 525 fathoms, the ship quickly drifted into 900 fathoms, so steep was the incline.

From Gibraltar the "Challenger" proceeded in a westerly direction, in order to get on the direct line between Lisbon and Madeira, as laying a telegraph cable between the two places had been contemplated, and the soundings on that line were required for it. It will be observed that much deeper water was obtained on the way out, than at the extremity of the line. In 10° west, 2,500 fathoms were obtained, while 60 or 70 miles west of it, only 1,500, while still shoaler water is found outside. This would lead to the hypothesis that another, but submarine, basin exists, similar to those of the Mediterranean and Black Seas, having an outlet between Madeira and Canary islands; and the sounding afterwards obtained of 2,400 fathoms, almost midway between the islands, would add to the probability of the inference being correct. A more minute examination of the vacant space between the African coast and the existing line of soundings would be most interesting; and could the contours of this sea be drawn, with Madeira on the one hand rising some 13,000 to 20,000 feet above the neighbouring land, and Teneriffe on the other, towering some 4,000 or 5,000 feet beyond that, how it would dwarf into insignificance our Gibraltar and the noble headlands we now think so much of! On the line of the proposed cable the water deepened to 2,000 fathoms towards Madeira, and that depth was carried close up to the island.

The "Challenger" reached Madeira on the 3rd February, leaving on the 5th for Teneriffe. At Teneriffe a party of the naturalists ascended the peak up to 9,000 feet, and they wished to complete the ascent, but could not prevail on the guides to accompany them. .

Leaving Teneriffe on the 14th, a course was shaped to the south-east, and when 57 miles from the Peak, 1,890 fathoms were obtained. At this station the specific gravity of the water from the bottom was less than that at the surface. The weather being fine, the opportunity was a good one for trying Mr. Siemen's ingenious differential resistance coil. It was tested in comparison with the Miller thermometer at 100, 200, 500, 700, 800, and 1,000 fathoms respectively. The difference at 100 fathoms was 2°— in the Seimen's, which gradually changed to 2°+ at 1,000 fathoms. With any motion in the ship, the difficulty in reading off a delicate galvanometer appears to be an insurmountable objection to this otherwise valuable instrument,

and in the absence of the regular thermometers, could not be depended on.

The serial observations of the temperature of the ocean at various depths were now commenced, and as this is decidedly one of the most important objects of the voyage, I may be pardoned briefly describing the *modus operandi* of obtaining them. One thermometer only is secured to the sounding line just above the sinkers to register the temperature of the water at the bottom, but for the serial temperatures, a line is used specially for the purpose, to which a lead is attached. A thermometer is secured to the line near the lead, and lowered 100 fathoms, then a second, and at 200 fathoms a third, and so on, as many as prudence dictates to trust the line with—as each thermometer is secured to the line, the indices are set. The line is let out to 1,500 fathoms, and then hove in. As the thermometers come up they are carefully released from the line, the indices read and entered in a book, with the corresponding depth and number of the instrument. The operation is then repeated until the series is complete. In some localities, as in the Gulf Stream, these temperatures are taken towards the surface at every 50, 25, or even 10 fathoms, but the serial temperatures have not been carried beneath 1,500 fathoms, as it will be seen by the sectional drawings that the temperature decreases but little from that depth to the deepest water, so that for all practical purposes it is sufficient. The observations, in all cases, have been taken at the same relative depths, so that conclusions can readily be drawn from them by analogy.

As might be expected, in the vicinity of volcanic islands, there were great inequalities in the bottom, and 50 miles outside, a depth of 1,945 fathoms, 1,525, and near that, to the southward, 2,220 were obtained, showing some steep acclivities and depressions. The bottom specimens brought up, coincided with the soundings; from the shallower sounding, stones, sand, and shells were brought up, whilst from the others, globegerine ooze.

The water deepened to 3,150 fathoms at two-fifths the distance on the section, and then shoaled to 1,900 at three-fifths the distance, deepening again gradually to 3,000 fathoms 300 miles from Sombrero; thus there appear to be two deep basins or valleys with a rise between them, and agreeing in contour with a few soundings obtained more to the southward. The section from Cape Verdes to Bahia will be most interesting in connection with this part of the voyage and the two deeps found.

Another point of observation in this line of soundings is in the nature of the bottom; in all the soundings exceeding about 2,700 fathoms the bottom is red clay, while in the shoaler water of the bank between, it is ooze, and I cannot but think that this circumstance, though apparently trivial, will have an important bearing in the consideration of the physical condition of the deep. At one sounding on this line, that taken on the 21st, in 2,740 fathoms, the sounding rod when it came up, was found to be entangled in the first 100 fathoms of line, that quantity having been paid out after the weights were down. This proves that the bottom water at that time must have been per-

fectly still, and that the rod must have been sticking upright in the mud at the bottom.

On the 14th March, in 1,900 fathoms, the hempen tangles attached to the dredge brought up, what Dr. Wyville Thomson calls, a "handsome decapod crustacean." I should probably call it an overgrown prawn, about 5 inches long—its generic name is "Deidamia leptodactyla"—but my object in mentioning it, is in the remark that it had no organ of vision, indeed no eye-stalks. Now, without getting away from my subject, it will be a nice question as to where the use of eyes ceases in ocean animal life. It certainly will not depend on the penetration of light through the ocean depth, as Dr. Carpenter brought up animals with *well developed* eyes, from a depth where no one can pretend to say there could be light; and if I remember rightly, phosphoric agency was brought to bear, to account for it; but I must not get out of my depth in the natural history department, but Professor Wyville Thomson mentions many strange anamolies in ocean animal life, which doubtless will be well considered on the conclusion of the voyage. Permit me, without further comment on this line of sounding, to bring you to an anchor at once at St. Thomas; this occurred on the 16th March.

An examination of the deep-sea-temperatures between the Canary Island and the West Indies is interesting. They show a stratum of water of equal temperature of 49°, at a uniform depth of about 380 fathoms, the water above gradually increasing in temperature, and that below decreasing. The temperature at the bottom varies but little, it being 35·6° on the African, and 34·9° on the other side of the Atlantic.

On the 24th the "Challenger" was again under way for Bermuda, first taking some soundings, and dredging in the immediate vicinity of the islands, and then stretching away to the northward towards Bermuda.

On the 25th, when only 80 miles from the land, a sounding was taken of the greatest known depth in the world, viz., 3,875 fathoms (nearly 4½ miles); not imagining that so near the islands so great depth of water would be found, only 3 cwt. of sinkers were used with the Hydra-machine, two thermometers and a water bottle were attached to the line. The line was 1 hour 12 minutes in running out, the last 100 fathoms taking 3 minutes 18 seconds: the progressive time intervals here proved of great value. The small dredge was let down, and this extraordinary depth was dredged with 5 miles of rope; the dredge on coming up brought a small quantity of mud, but with little sign of animal life.

From this deep sounding, the water shoaled 1,000 fathoms, at a distance of 110 miles, and then continued without any great alteration until close to Bermuda, at which place the "Challenger" arrived on the 4th April.

The several deep soundings taken around Bermuda, prove it to be a peak on which the coral animals have built the islands; and from the fact of there being considerable magnetic disturbance at different stations on the islands, it may be inferred that, unlike the coral formations of the Pacific, there has been no subsidence of the mountain. There are two or three other peaks similar to that of Bermuda, for

instance, the Sainthill and Milne banks, one with 100 fathoms, the other with 80 fathoms on it. These are well authenticated soundings, and had the peaks been a few fathoms nearer the surface, doubtless we should have had two islands similar to Bermuda.

The "Challenger" left Bermuda on the morning of the 21st April, and soundings were taken in the immediate vicinity of the island. On the 24th, when 45 miles to the westward, after sounding in 2,650 fathoms, and when the dredge was at the bottom, a boat was lowered and anchored by the dredge, and the surface current was ascertained; the currents at different depths were then tried down to 600 fathoms; a movement was found to 500 fathoms, but the observations varied so much in direction and force, as to preclude any deduction from them. They were again tried 200 miles to the north-west with more uniformity both in direction and force.

Proceeding to the north-west towards New York, the deepest water, 2,850 fathoms, was found about midway between Bermuda and the southern edge of the Gulf Stream. Soon after noon on the 30th, this southern edge was crossed, the temperature of the surface-water changing suddenly from 65° to 72°; a sounding of 2,425 fathoms was obtained just before it was reached. On the 1st May, being in the middle of the Gulf Stream, great interest was evinced in the day's work. The temperature of the surface-water had here increased to 75°. The preparations for sounding were made with great care—4 cwt. of sinkers were attached to the line, and in lowering them into the water, a strong current at once became evident, setting to the E.N.E., which necessitated the ship being steered to the W.S.W. at the rate of three miles an hour, in order to keep the line "up and down;" each time the line was let go, the bight went astern on the surface; the line was then held from running out, until it was again up and down, when it was let go again to be checked after another 100 or so fathoms had run out, this of course rendered the time-intervals of no avail. At 1,800 fathoms, the line carried away, and another trial was made, and after 2,600 fathoms had run out, supposing it had reached the bottom, it was hove in, but the weights had not disengaged, and there was no sign on the rod that it had touched; it was therefore only recorded as a "no bottom" sounding. The current-drag was then lowered 100 fathoms, and the surface-current passed the watch-buoy at a very slow rate; at 350 and 400 fathoms, the surface-current ran past it at the rate of a mile and three-quarters an hour, so that probably at that depth there was no current, as the current of from three to four miles an hour acting with great power both on the watch-buoy and on the line to 100 fathoms, would be sufficient to move the current-drag at the rate to make up the difference. From some serial temperatures taken in the afternoon, it was considered that the Gulf Stream at this position did not extend beyond 100 fathoms in depth, for after that, the water got rapidly cold, showing that a mixture of the Labrador current and the regular warm water of the Bermuda regions was taking place.

Conclusions were also drawn from these and other observations, that at this section of the Gulf Stream, it is 57 miles wide and 100 fathoms

deep, that the rapid current was only on its western edge, and did not exceed a breadth of 15 miles, that the rate of the current is 3½ to 4 miles an hour, and that the temperature of this belt of rapid current exceeded by 3° the other parts of the stream. On reaching the edge of the bank extending from the continent, the course was changed, and soundings taken to the southward of the bank towards Halifax.

On the 19th May the "Challenger" left Halifax on her return voyage to Bermuda; on the 22nd she sounded close to the position of the Hope bank, on which there is said to be only 49 fathoms; but no indications of it were found. On the 23rd the Gulf Stream was re-entered, and a sounding obtained of 2,800 fathoms. The next day the warm water of the stream was found to extend only 50 fathoms down. From the southern edge of the stream the depth remained about the same, 2,600 fathoms, to Bermuda.

In the return voyage across the ocean to the Azores, there is not much to comment on; the water suddenly deepened to 2,360 fathoms at a distance of 60 miles from Bermuda, and then gradually to 2,850; the deepest water, 2,875 fathoms, being one-third the distance from Bermuda. It then very gradually shoaled the next third, and then more suddenly towards the islands from 2,000 to 1,000 fathoms, which latter depth was carried close up to Fayal. The trawl was let down at the deepest part of this section, and from this tremendous depth, many star-fishes, sea-slugs, and worms were successfully brought up. From the cast of 2,175 fathoms, a hermit or soldier-crab was brought up, and from a similar depth, a remarkable crimson prawn, which I doubt not is safely pickled and will be brought home, and I may remark that a small turtle was caught, covered with barnacles and small crabs; he must have been some time at sea, and was decidedly out of his latitude, the barnacles and crabs were doubtless also pickled, but I am reasonably doubtful if the turtle was.

On the 27th June, when about 220 miles from Flores, observations for sub-currents were again made, with the same incongruity of direction; for while the surface current set to the southward, that at 50 fathoms was S. 59° E., and at 100 fathoms N. 82° E., but the serial temperatures denoted a remarkable change in the iso-thermal lines, evidently owing to the under current; the trawl, on coming up, was found entwined round the spar, and 25 fathoms of rope foul of the spar, this was attributed to the strong under current.

The "Challenger" reached Fayal on the 1st July, but small-pox being prevalent on the island, did not remain, and proceeded to St. Michael, where her inmates recruited, and for the few days they were there, greatly enjoyed the beauties of that beautiful island, of which, comparatively, so little is known. Leaving St. Michael's on the 9th, soundings were taken to Madeira, the depth being tolerably even at 2,600 fathoms, rising towards the islands. From Madeira, a course was shaped direct for Cape Verde Islands, passing westward of the Canaries. Midway between Madeira and Palma, 2,400 fathoms were found, while southward of the last-named island, only 2,000 fathoms were obtained; but midway between the Canaries and Cape Verdes, it increased again to 2,400 fathoms, shoaling again to 2,000 towards the

westernmost of the Cape Verde Islands. The "Challenger" reached St. Vincent on the 27th July.

I have not attempted to go into the detail of all the soundings taken, nor have I stated when and what serial temperatures were taken, and where dredging and trawling were carried on. Did I attempt it, it would sound but a jumble of statistics without imparting knowledge. I can only touch the leading and most striking features of the voyage, leaving to the student the careful consideration of the iso-thermal diagrams, which teem with interest in regard to the movement of the "great waters."

In thus sketching the work accomplished by the expedition in the first seven months of her voyage, but a poor conception can be had of the labour, trouble, and anxiety attending its execution. To summarise it is impossible, but without taking into account any soundings taken under 1,000 fathoms, 48 were taken between 1,000 and 2,000 fathoms, 56 between 2,000 and 3,000, and 4 exceeded 3,000, and in these 108 soundings, there was only one miss. In sounding alone, 243 miles of line have been run out and hauled in again. At about 60 stations, either the trawl or dredge was let down, and the quantity of rope veered out was from one-third to one-fourth more than the depth of the water. At upwards of 50 stations, serial temperatures were observed, generally at every 100 fathoms to 1,500, and these supplemented by many intermediate observations between. Near the surface the quantity of line veered out and hauled in again for these two purposes, it is impossible to estimate, and this has been the work of the nautical branch, irrespective of magnetic, hydrographic, and (I suppose we must call them) meteorologic observations.

The accompanying chart of the "Challenger's" route, with soundings, &c., is inserted with the kind permission of the proprietors of "Ocean Highways," a journal devoted to geographical record.

Evening Meeting.

Monday, January 27th, 1873.

Captain J. G. GOODENOUGH, R.N., in the Chair.

NAMES OF MEMBERS who joined the Institution between the 21st and 27th January, 1873.

LIFE.

Leask, William, Capt. 22nd Essex Rifle Volunteers.

ANNUAL.

Llewellyn, W. R., Major R.A.
Treffry, Frederick, Assistant Paymaster Control Department.
Martin, F. S., Ensign late 58th Regt.
Chamberlaine, T. J., Lieut. Ceylon Rifles.
Gardiner, A. M., Lieut. R.N.
Gordon-Cumming, Sir W. G., Bt., Capt. Scots Fusilier Guards.
Burls, E. Grant, Capt. 1st Surrey Art. Volunteers.
Stuart, W. T., Capt. Bengal Staff Corps.
Thornhill, H., Major Royal Horse Artillery.
Pamphilon, F. W., Lieut. 2nd South Middlesex Rifle Volunteers.

A PROPOSED METHOD OF MOUNTING HEAVY ORDNANCE AT SEA ON THE PRINCIPLE OF THE BESSEMER SALOON.

By Lieut.-Colonel A. Strange, F.R.S., Inspector of Scientific Instruments to the India Government.

A short time ago, two letters from me, bearing the title of "*A Ship of the Future*," were published in the *Times* newspaper.* In these letters I made the proposal indicated by the title of the present paper. The proposal appearing to the Council of this Institution worthy of further consideration, they did me the honour to beg me to prepare a paper on the subject, a request with which I felt bound to comply. I undertook the task, however, believing that more light would be thrown on the questions to be mooted by the discussion which they will, as I hope, undergo at the hands of accomplished Naval and Military Officers and Engineers in this theatre, than by the contents of the paper itself.

It is not without misgivings that, as a landsman, I venture to address seamen on naval guns and ships of war, and I must, at the outset, bespeak their indulgence for my inevitable shortcomings whilst struggling in a foreign element, and beg them, if I should happen to get out of my depth, rather to give me a friendly lift than force my

* 30th November and 6th December, 1872.

head under water, yielding me credit for at least honesty in my endeavour to contribute something to the most difficult and the most important national problem of the day.

So many descriptions have lately appeared of Mr. Bessemer's contrivance for giving stability to the saloons and cabins of Channel passenger ships, that I think I may, in order to economise time, take for granted that the main features of his arrangement are pretty generally understood by such an audience as this. The idea of mere suspension to counteract a ship's motion is probably as old as the idea of ships themselves. But mere suspension, as every one knows who has observed a binnacle compass, or a hanging lamp at sea, is insufficient to secure perfect quiescence. The point of suspension itself partakes of the general motion of the ship, and this communicates always an independent swaying motion to the suspended body. Various frictional devices have been adopted for the purpose of lessening this swaying motion, the success of which have been, and could only be, partial. Mr. Bessemer is the first, so far as I know, who has gone to the root of the matter, and devised appliances to arrest these swaying movements, by means of an active external force under the control of human agency. Many mechanical contrivances are applicable to the purpose, but probably none would equal in simplicity, sensitiveness, durability, facility of manipulation, and power, the peculiar hydraulic apparatus which he employs. In his Channel ship, he has applied his invention to counteract only the rolling motion of the ship; but he has stated publicly, what cannot be doubted, that the same arrangements can be applied to counteract the ship's pitching motion also. Mr. Bessemer has recently shown me his large collection of elaborate drawings, illustrative of his labours on this subject, many of which exhibit clearly a variety of ways in which cabins and saloons can be suspended and controlled in two rectangular planes, so as to counteract both rolling and pitching.

Assuming that this can be done in the case of a large ship's saloon, it appeared to me,—the moment I saw Mr. Bessemer's great working model,—that, by the application of the same principles, the platform of a naval gun could equally be kept horizontal. I accordingly threw out that suggestion in a letter to the *Times*, and Mr. Bessemer immediately wrote to the same journal,* approving of it, and adding that, "he does "not hesitate to say that all Colonel Strange has proposed is perfectly "capable of realization." It is here right that I should mention that Mr. Bessemer, whom I had then only met once in my life,† gave me full credit, in very handsome terms, in the letter above cited, for the originality of my suggestion. Justice, however, requires that I should add that he has since shown me the specifications and drawings of his patents relating to suspended saloons, and that these contain distinct allusions to the applicability of his invention to the mounting of Naval guns. An act of spontaneous generosity such as this is too rare to be passed over without full and public acknowledgment.

* 3rd December, 1872.

† I may further mention that I am in no way connected with Mr. Bessemer by any pecuniary interest, nor am I a shareholder in the Bessemer Saloon Company.—A.S.

The great advances which, within a comparatively recent period, have been made in the construction of ordnance by the introduction of rifling, in the forms of projectiles, in the manufacture of explosives, and in theoretical gunnery, have been, to a great extent, lost to the Navy; the movement of ships, even in moderate weather, being fatal to what on land would be considered accurate fire. If we take a quarter of a mile for the distance of the enemy, as our standard of comparison, a distance at which very accurate practice is made on land, and 10° for the angular roll of the attacking ship, we find that the maximum deviation of the shot will be 230 feet, or from 10 to 15 times the width of the object fired at. This deviation increases or diminishes directly as the distance or the angle of motion, and may, therefore, readily be deduced for any given case by bearing the above numbers in mind. The mode of firing at sea may be briefly described, in general terms, as follows:—The sight having been adjusted for the assumed distance, the gunner watches the range of the gun; at one extreme of the ship's roll he sees it pointing far above the enemy, at the other far below, and he fires the gun at the moment when he considers it to be midway between these extremes, pointing at the enemy. If the roll is small and slow, the right moment may be seized by a skilful man with some approach to certainty; but when it is large and quick, any success which may reward his endeavours must be, in a great measure, a matter of accident. No doubt cleverness, constant training, and long experience, will do wonders with this primitive system of snap-shooting, but it is difficult to understand how any one can maintain, as some do, that no advantage is to be expected from arrangements which, if practically feasible, will substitute comparative certainty of fire at sea, for a system largely partaking of chance.

I have endeavoured to obtain data for estimating the degree of accuracy now attainable at sea under ordinary conditions of weather, but have not been successful in discovering any extensive series of well-considered and satisfactorily-executed experiments on this problem; but in the course of preparing these notes, I have re-perused a paper by Captain P. H. Colomb, R.N., on "The Attack and Defence of Fleets," published in vol. xv of the Journal of this Institution, which bears upon it, and as the author of that paper, with whom I have not the pleasure of being personally acquainted, is looked up to as one of the most scientific officers in the Navy, I cannot do better than quote some of his remarks on the subject before us. He says:*—"Unfortunately, "precise figures are wanting here, and very little attempt has been "made to obtain them, as they can alone be obtained by experiment. "The inquiry takes the form of two questions: *How many shot* will "strike the 'Monarch' *in a given time in the open sea*, and what amount "of damage will they do? And I must own it has struck me as "alarmingly suggestive that I cannot get an answer off-hand to *either* "*query*. Nobody seems to have made the calculation, even with such "data as are obtainable, and no steps have been taken to improve the "data. It is true, I believe, that the materials for determining the

* Page 411.

" number of shots which will strike a given vertical target at a given " range, when fired *from a steady platform*, are obtainable, but such a " determination must be a very fallacious guide as to the *results at sea;* " nor am I sure that even the materials obtained have been applied to " determine the practical question." This paper was read on 3rd April, 1871. I have not been able to ascertain that our knowledge has since made much progress regarding one of the two questions here referred to by Captain Colomb, namely, accuracy, with which alone we are at present concerned.

Captain Colomb then proceeds to discuss, with his usual ability, the meagre data in his possession, and finally arrives at the conclusion thus expressed :—

" I must make a reasonable assumption on the facts I am possessed " of, and state a mean position between the result deduced from the " Vigo experiment and those taken from prize firing, and I lay it " down that 10 per cent. of the 'Monarch's' shot will strike a " 'Monarch' in action at 1,000 yards."

Now I think all must admit that such a result as only one shot in ten hitting at 1,000 yards, proves that we have here a very wide field for improvement. It is clearly and ably shown by Captain Colomb, that into modern naval warfare, time will enter as a powerful element, and time is obviously identical with accuracy, other things being equal. It is scarcely necessary, however, to insist on what is on every hand admitted, not merely by naval artillerists, but perhaps even more explicitly by naval architects, one of whose main objects for years has been to confer on vessels of war the steadiest possible platform. As it is well known that maximum steadiness of platform is not combinable with maximum stability or safety from capsizing, the endeavour to realize these antagonistic conditions has cost our naval constructors the greatest anxiety, and contributed to, if it did not directly bring about, the terrible loss of the "Captain."

My present paper is, according to its title (which I may mention is in the exact words prepared, not by myself, but by the Council), but a "proposal," and makes no pretence to be a demonstration. It would be quite impossible, or I should rather say entirely beyond the scope of my ability, to give in the course of one hour a complete demonstration of what is an intricate problem, almost indeterminable for want of data, and also to place fairly before you the consequences flowing from its solution.

I must therefore put my case hypothetically rather than argumentatively. I must take a great many things for granted, and base my proposal on postulates in default of proofs. But when you come to know the extreme moderation of my proposal you will, I think, allow there can be no great objection to its adoption. My postulates, or, if you will, my assumptions, are—

1. That increased accuracy of fire at sea is very desirable.
2. That such accuracy is at present defined less by the precision of our naval guns, than by the unsteadiness of their platform.
3. That steadiness of platform has hitherto been sought by means of modification of the ship's external form only.

4. That steadiness of platform, so sought, is limited by considerations of the ship's stability or safety from capsizing.

5. That hence, if the demand for steadiness of platform can be complied with by internal appliances, naval architects will be unfettered in their endeavours to give the maximum stability and sea-worthiness to ships of war.

6. That Mr. Bessemer's system of controlled suspension is applicable as a means of securing a high degree of steadiness of platform by internal construction.

The definite proposal I now make is, that this controlled suspension should be put to the test of careful and impartial trial. There would be two main points to test: First, whether Mr. Bessemer can, as he has said both publicly in the *Times* and privately to myself, that he can, design mechanism fitted to carry heavy guns on board ship, and to maintain the horizontality of their platforms, even in bad weather, within an extreme range, in any plane, of one degree; and secondly, whether with guns so mounted, the accuracy of fire will be much greater than under the present system As to the first point, the illustrations and explanations of Mr. Bessemer satisfy me that, though there will be many difficulties to overcome, on which, as matters of detail, I have no time to dwell, he will succesd in the undertaking.

As to the second point, I can only express my anticipation that the result will be a very great advance in naval gunnery, calculated to bring out, and turn to effective account, the enormous improvements which have in modern times been made in artillery implements of all kinds. But it is evident that the introduction of a gun platform devoid of sensible angular motion, will necessitate a radical revision of our present system of naval gunnery, amounting to a revolution; and as it may be some time before the drill best adapted to the new system, is settled, and men thoroughly trained to perform it, the whole of the good effects of steadiness of platform may not immediately show themselves.

One part of the drill which I apprehend will undergo a total change will be that vertical aiming by eye along the sights of naval guns will be, under all ordinary circumstances, dispensed with. Since gravity, assisted by Mr. Bessemer's hydraulic apparatus, supplies a practically permanent horizontal plane, the gun may be set vertically to the elevation required by the distance of the object (in any case supposed to be known approximately), and the moment for firing will be intimated by a spirit level, the indications of which can easily be conveyed by optical expedients, to any part of the ship in which it may be most convenient to post the man appointed to fire the gun, electricity being of course employed for firing it. The horizontal direction or training of the gun will, in the case of bow-firing, which seems every day to be advancing in favour, be given by the man at the helm, and the truth of the alignment can be conveyed by optical means to the same field of view as that in which the indications of the horizontal spirit level are made visible to the gunner charged with the duty of firing.

It is right that I should here mention that Mr. Bessemer foresees another solution of the problem of accurate firing. He proposes to add

a peculiar apparatus, invented by himself, which shall enable the gun to fire itself automatically at the very moment when it shall have been brought by the motion of the ship, unaided by any suspension arrangement, to the vertical elevation required by the distance of the object. The apparatus in question of course fires the gun by means of an electric discharge. I shall not attempt to describe its details, but shall leave that for Mr. Bessemer to do when and how he sees fit. But I have examined it, and believe it will act efficiently in the case of a broadside gun, which is subject principally to one motion only, namely, the vertical motion caused by the rolling of the ship. I am doubtful whether in its present form it will do for bow guns, which, being affected by the pitching as well as the rolling of the ship, are subject to very complex movements, rendered the more so by the fact that the most energetic of them, the rolling, is perpendicular to the line of fire, and takes place round an axis not coincident with the axis of the gun.

Mr. Bessemer's self-acting igniter is, however, eminently deserving of trial. I am disposed to think that a combination of this with the controlled suspension will be better than either, separately, for bow guns.

The trial of these two contrivances need not be an expensive undertaking, and the object sought to be obtained with them, fully justifies its cost. The result to be aimed at, should be more of a comparative than an absolute character. Hence the two systems, the old and the new, should be pitted against each other. To do this, two ships should be employed. The one representing the old system should, in order to give it fair play, be of a build giving a reasonably steady platform. The ship carrying the new appliances may be a good sea boat of ordinary build. The guns, projectiles, and powder in both should be absolutely identical in every respect; and, in order to eliminate unsuspected differences, the guns should be interchanged frequently. Practice should be made in all weathers and at all distances. The gunners employed for working the old system should fairly represent the skill of the day, and those employed for working the new system should be placed for instruction under its advocates or representatives, and the experiments be tried under their supervision.

I will now, for the sake of argument, anticipate the result, and assume it to be decisively favourable to the new system, and will proceed to inquire what would be the consequences of such a result.

First, it can hardly be doubted that, if by means of these contrivances, we can make at 1,000 yards, say six or eight hits in ten instead of only one in ten, which Captain Colomb estimates to be the present practice, it will be expedient to apply them in existing armour-clad ships. We shall then have combined the maximum attacking with the maximum defending power in the same vessel, and have thus,—supposing these contrivances productive of no inconveniences with regard to internal arrangements,—undeniably improved her as a fighting machine. The fair probability of such a result would certainly justify the moderate cost of testing these appliances experimentally.

But may we not extend the range of our thoughts, and speculate on

the possible influence of accurate firing at sea in all weathers on the great problem of the construction of our ships of war?

It is of no use to cry out against another reconstruction of our Navy, another there will be, and another and another, until the restless brain of man sinks to repose, or the secrets of nature have been exhausted. It will not do to say "let well alone," where nothing is settled, nothing is well. It will not do for England to wait to see what other nations are doing, and "govern herself accordingly." In Naval supremacy at least, whatever she may do in other matters, she must lead if she is to exist. On no point, on no question of policy, are Englishmen so perfectly unanimous as on this, that their Navy must be the most advanced in efficiency, and the most powerful in the world. Self-interest, prejudice, excusable love of old and hitherto successful expedients, financial considerations, must all yield to the well-grounded conviction that, until that happy but apparently remote period arrives, when the lamb shall lie down with the lion, the vast dominions under the British Crown can be secure only on the condition that our Navy is supreme on earth.

And here I must give voice to the feeling which oppresses many a thoughtful Englishman,—that Naval questions are made too much a political battle-field. Of this dangerous tendency we have had but recently some lamentable examples, on which, in this Institution, it would not be proper for me to dwell. But it is impossible for one independent of political shackles as I am, to approach the subject on which I am addressing you without looking back to the party contests which it has almost invariably provoked, and without protesting against the unpatriotic and dangerous subordination of imperial, to individual and political, interests, which has so often interfered with sound decisions on the paramount problem of Naval construction. Against this hindrance, when it exists, it is impossible for reasoning to prevail, and the consequences must be on the heads of those who cause it.

But there are other hindrances besides. Self-interest of a narrower kind, sometimes in a simply sordid form, sometimes with pardonable features. Certain engineers, inventors, and manufacturers, represent one class who have benefited enormously by the course which Naval construction in late years has taken, and who would naturally, though selfishly, resist any change calculated to lessen or divert their accustomed profits. Another class are official men and Naval Officers who have attained honourable distinction by their mastery of existing methods, and who are excusably loth to go to school again. A Naval Officer, for instance, who had served chiefly in large armour-clads, and had attained well-deserved eminence in handling them, could not reasonably be expected at once to acquiesce in the abandonment of the floating fortress in which he had justly taken such pride.

Even, therefore, if I could demonstrate the necessity for a reconsideration of the whole subject of Naval construction, I well know the tremendous resistance which political considerations, pecuniary interests, official prejudice, and professional preferences would oppose to the acceptance of the plainest truths. Still, believing, as I do, in the ultimate prevalence of truth, and knowing that the sooner it is

enunciated, the sooner it will be accepted, I shall not be deterred by any amount of possible opposition from stating what I firmly believe to be the case, namely, that the star of armour-clad ships has reached its culmination, and that it will henceforth decline.

In the short space of time at my disposal, I can only broadly state the grounds on which I hold this belief. First, the instinct of the nation has gradually become more and more apprehensive of these ships. This feeling probably dates from the terrible loss of the "Captain." Suddenly the fact was forced upon the public mind that a recent and costly invention had dangerous properties which no one, not even the lamented inventor himself, had foreseen; and the conclusion, however exaggerated, became general, that in ship-building for the Navy we were groping in the dark. Not only is the comparatively uninstructed public mind uneasy, but the professional mind also, with of course numerous exceptions, is far from being assured. Nothing, since the "Captain" disaster, has occurred to allay this uneasiness; on the contrary, we every day hear of some new form of dangerous activity, or as dangerous inertness, peculiar to this race of ships. And no sooner is a new specimen of the race brought into the world than, even amongst sailors and experts, there is at once a shaking of heads and a shrugging of shoulders. Will she steer? Will she stem the Atlantic waves? Dare she move an inch out of smooth water? Has she not required hundreds of tons of ballast to keep her upright? If masted, how much sail can she carry in a gale without capsizing? If unmasted, how will she behave in an Atlantic storm, with her engines disabled by accident, or her coal exhausted? And in action, how will she fight? Will her armour, after all, preserve her against every possible antagonist? And then what did she cost? What fraction of the national defences does she represent? Are we sure the cost has secured us what we want,—safety in all weathers, victory in every fight? And finally, costing so much as she has done, how many such can we afford to possess, and will they be sufficient for every requirement, for the defence of our enormous and scattered possessions, and our gigantic commerce?

These are some of the innumerable questions that are current in society, and that must pass through the mind of every thoughtful man who, without pretending to study the subject seriously, yet keeps himself informed by means of newspapers, periodicals, and lectures, of its salient features.

Those who go a little deeper, and read the Parliamentary reports of official inquiries, and associate with persons professionally or departmentally engaged in Naval affairs, find stronger evidence still of the doubts and the difficulties which shroud the tremendous subject. The first and great fact by which, at every stage of their inquiry they are arrested, is, that those engaged in providing a Navy for the country, are divided into two main camps, irreconcilably hostile to each other—the artillerists and the armour-platers. These rarely, if ever, unite for the common object of producing the best total result. The artillerist simply despises the armour, and tells you he can produce a gun to pierce any you can make your ship carry; and the armour-plater

retorts that many of the solid shots will glance, some break up without penetrating, and most miss altogether, whilst all the dreaded shell will be kept out; and that, when it comes to close quarters, no ship can withstand the armour-clad's ram.

The Report of Lord Dufferin's Committee on Designs of Ships of War, is not calculated to re-assure the reader. I have endeavoured to arrive, for my own satisfaction, at the net result of that inquiry, and after weighing as impartially as I can all the contradictory opinions of witnesses which it contains, and the hesitating tone of the two Reports founded thereon, I have come to the conclusion that a feeling of uneasiness as to the safety and sufficiency of armour-clads permeates the whole of these voluminous documents. A critical analysis that would justify this judgment would itself fill a volume. There runs through the whole, where the tone is not absolutely condemnatory, a strain of deprecatory exculpation which left on my mind the impression that even the avowed advocates of armour had latent misgivings that they did not dare own even to themselves. It is to be noticed, too, that few, if any, of the sailor witnesses or Committee-men ventured to grapple with the question of the safety of certain new armour-clads. This awkward problem was left, by common consent, to two distinguished mathematicians, whose conclusions are as remarkable for caution as their investigations are for ability.

I will give a few brief extracts from the Report (from which, however, Admirals Elliot and Ryder dissented on many points), which will, I think, fully justify the general conception I have formed as to its tendency.

At page ix we find this passage:—

"Hitherto the powers of offence, represented by artillery, and of defence, by armour, have advanced almost *pari passu*, sometimes one, "sometimes the other, slightly in advance; but we appear now *to be* "*closely approaching* a period when the gun will assert a *final* and "definitive superiority."

In the next page (x) we find the Committee doubting whether the above opinion may not have gone too far, in the following words:—

"Even assuming that absolute impenetrability to shot proves to be "unattainable, it is still our opinion that *the time has not come* to "throw off armour *altogether*, but that it is necessary that the first "ranks of our ships of war should continue to carry armour of as "great resisting power as possible."

I do not quote these two passages for the purpose of fixing a charge of inconsistency on the Committee, on the contrary, they are quite consistent; but to my apprehension they are the words of honest and well-informed men, burdened with a tremendous load of responsibility, brought face to face with the inevitable, and yielding to it with stubborn reluctance. Nor is it wonderful that the Committee should feel apprehensions regarding the approaching supremacy of the gun, when we find them quoting, between the two above cited passages, the assertions of such high authorities as Sir W. Armstrong and Sir Joseph Whitworth, that they are prepared to produce guns capable of penetrating respectively well-backed armour 20 and 24 inches thick (pp. ix

and x). I shall presently have to tell you that another authority of eminence equal to these, is prepared to furnish guns which will throw even these tremendous performances into the shade.

I will now quote a passage from the Report, which bears directly on the immediate subject of this paper, namely, accuracy of fire at sea.

At page xi the Committee say:—

"It is a well known fact that those peculiarities in the design of a "ship which result in what is termed 'great metacentric height,' and "consequent stiffness under canvas, are amongst those which materially "tend to produce quick rolling and to make the ship uneasy in a sea-"way."

"Nothing," they proceed to say, "*is so detrimental as this to the* "*accuracy of artillery fire*, which, in consequence of the reduction in "the number and increase in the weight and cost of projectiles com-"posing a broadside, has now become of far greater importance than "at any former period. Naval architects have been induced therefore "to seek steadiness of platform by diminishing, as *far as safety would* "*allow*, the statical stability and stiffness of the ship. In some recent "instances (*e.g.*, the 'Inconstant' and the 'Invincible' class) this was "carried to a degree which, together with an alteration in the distribu-"tion of weights during construction, has led to a considerable weight "of ballast being placed on board these ships in order to correct the "crankness so caused."

Accepting these views with the respect to which their source is entitled, we find these three positions firmly established in the compact passage I have just quoted:—1. That accuracy of fire is of the highest, and of increasing, importance. 2. That the conditions conducive to accuracy, if sought by modifications of the ship's external form, are opposed to the conditions conducive to her safety. 3. That in the endeavour to hit the mean between these antagonistic conditions, the safety of some ships having been compromised, large amounts of dead weight has had to be added.

But then follows a most remarkable sentence in the same page (xi), as follows:—

"But although experience has shown that in these instances the "principle of giving up stiffness to obtain steadiness of gun platform "was carried *somewhat too far* [for safety], it is much to be regretted "that it should be necessary in any degree to abandon *the very impor-* "*tant object* which the designers of those ships had in view, and *if any* "*means can be adopted* by which steadiness of platform may be made "to accompany great stability or stiffness, a most valuable result will "have been achieved."

Throughout the whole of this Report and Evidence I have been unable to find any suggestion for uniting the two objects here so emphatically pronounced to be all-important, but by modification of the ship's external form. There is no hint that I have been able to discover that the proposal it is the object of this paper to submit to public discussion, solves a problem which, when the Report was published last year, was inferentially, if not directly, admitted to be then

insoluble, namely, to obtain accuracy by contrivances within the ship, and safety by her external form.

But to revert again to armour. Let us endeavour to fix some landmarks in the wilderness of arguments by which the subject has been obscured.

1st. Is armour in itself, apart from its defensive functions, advantageous to a ship? Will she sail or steam better or faster, or more safefy, for having parts of her sides loaded with enormous masses of iron? Need I answer such a question? Armour, then, will do a ship, simply as a ship, no good. It is not likely to be added, for instance, to merchantmen and mail steamers.

2nd. Is the effect of armour on the sea-going properties of a ship neutral? or does it involve, when of extreme thickness and extent, modification of form, increased size beyond what might otherwise be required, and augmented engine power? We know it does bring all these train of consequences. It is then not neutral.

3rd. Does it add to the cost of an individual ship? We know it does, enormously. Has the total number of ships of war possessed by a nation any direct relation to the cost of individual ships? or, in other words, would our Navy have the same numerical strength in ships, whatever their cost? Or again, to put the question in a still more direct form, If it were found that defensive armour could be dispensed with, and that the present attacking force of the English Navy could be maintained for one-quarter what is now spent in defensive ships, should we not, being then able to afford it, largely increase our attacking force? If the answer to this question be not in the affirmative, then either our attacking force is already ample, which is not the general opinion, or we have paid for it *more than we can afford!*

4th. Is armour, if neither advantageous nor neutral, prejudicial to ships carrying it, simply considered as ships? There can be but one answer to this question. Armour *is* an evil.

5th. Admitting armour to be an evil from the architect's point of view, and a very costly evil, tending by its mere cost to reduce the numerical strength of the Navy, what are its properties which induce us to submit to its admitted drawbacks? What are the compensations?

This is the pith and essence of the inquiry. Let us examine it as well as our remaining space will admit. There are at present four known modes of naval attack:—1. By shells. 2. By ramming. 3. By Torpedos. 4. By solid shot.

Will armour, as at present used, keep out all four aggressors? Unless it will do so we are not fully protected by it. Of what avail is it to keep out every form of projectile but one, if that one is irresistible. Let us examine separately the four forms above enumerated.

1. *Shells.*—For argument's sake, I will assume that shells of every form and description can and always will be kept out; an assumption, however, which few artillerists will assent to.

2. *Ramming.*—The contrary assumption may here be boldly made. No existing armour-clad can resist the well-directed ram of a similar vessel. The recent case of the "Northumberland," in which the ram

was delivered accidentally, indirectly, and lightly, settles this question. We know that to inflict the blow in the best manner is difficult. Captain Colomb, in the paper already quoted, explains the theory of that mode of attack, and points out both how to conduct and how to evade it. But one blow, properly delivered by a well-fitted ship, would send her antagonist to the bottom.

3. *Torpedoes.*—These are nearly in the same category with ramming. They are, and probably always will be, difficult to explode at the exact moment and the precise place required; but if so exploded, can anyone suppose that the strongest conceivable ship would resist the eruption of a small volcano suddenly bursting out under her bottom?

Here, then, are rams and torpedoes on the side of the attack against shells on the side of the defence. Let us be fair, and allow, but only for the sake of argument, that the two attacking methods are uncertain, and that the defence from shells is effectual,—so far, then, we have armour on account of shells only, and it may be worth while to retain it and risk the ram and torpedo, which are remote dangers. Then how about

4. *Solid Shot.*—It cannot be doubted that, whilst the difficulties and uncertainties attending the use of the ram and torpedoes will tend to retard their development, there are elements about solid shot which must always encourage inventors to new exertions. Unlike both the ram and the torpedo, solid shot can be delivered from a distance with comparative safety to those using it. Unlike the other two, its reaction will not injure its own ship or her machinery, which ramming will probably do; nor will she run any risk of being involved in the fate of her adversary, as may happen accidentally with torpedoes.

To make solid shot effectual against armour, two things are necessary,—first, that it shall hit; secondly, that it shall hit hard enough to penetrate or disorganise the enemy. The first requisite has formed the subject of my proposal, and I need not again insist on the necessity for accuracy of fire at even considerable distances. As to the second, I said, in a previous part of my paper, that Sir W. Armstrong's and Sir Joseph Whitworth's undertakeings to penetrate respectively 20 and 24 inches of backed armour, will probably be far exceeded by an equal authority.

I allude again to Mr. Bessemer, who was kind enough to explain to me, a few days ago, the results to which his long study of this question had brought him.

He is prepared to produce the following gun:—Bore, 30 inches; rifled, throwing a solid shot, at low initial velocity, weighing 5 tons, burning the whole charge of powder (about 400 lbs.) by a series of explosions automatically ignited successively at regular intervals between the first moving of the shot from the breech and its escape from the muzzle, so that, although the aggregate power will not be lessened, but rather increased by perfect combustion, the total concussion will be distributed both as to time and locality instead of being, as at present, concentrated destructively to the gun. This gun will load itself. It will also fire itself, automatically, at the rate of one shot per minute, as I have already mentioned, at the moment when

correctly directed at the enemy. If the Woolwich 35-ton gun, throwing a shot of 700 lbs., threatens to put an end to armour-plating, what will be the result of our possessing, and of course of other nations also possessing, guns discharging with accuracy, at long ranges, projectiles of 16 times the weight, in the presence of which the Woolwich "infant," in boastful irony so named, dwindles to a baby plaything in reality.

Time will not permit me further to pursue, to their legitimate consequences, the effects which improved accuracy, combined with increased power in Naval ordnance, must entail on Naval architecture, on Naval tactics, and on Naval training and education. My belief, stated in general terms, is that the conditions of Naval warfare will approximate in the future more nearly than at present to those of land warfare. That in the former, as long ago came to pass in the latter, defensive armour, being utterly ineffectual to give protection against improved missiles, will be abandoned as a costly and useless incumbrance; and that supremacy at sea, as on land, will belong to that nation which commands the most numerous sea battalions, the most powerful arms, the highest maritime qualities, the most perfect organization, and the most scientific tactical knowledge.

For some time past, the course which Naval construction has been taking has been, in one respect, in direct violation of this analogy. We have been concentrating our maritime forces in single ships to an extent that seems full of danger. A great iron-clad represents at sea a division of troops on land; a break down of her engines may disable her, and place her at the mercy of the enemy; one blow from guns such as are now promised us, might send her to the bottom. What would be thought of military arrangements such that a single shot might annihilate a whole corps d'armée? That we should have some large ships may, perhaps, always be advisable; but that we should, as we now do, place our chief dependence on them, is, in the highest degree, imprudent. We cannot have them in sufficient numbers to enable us to afford sacrificing them; and a judicious sacrifice of part of the forces is of the very essence of war. What seems to be required is, a very large development of the gun boat element for coast defence and attack, and a sufficient number of ships no larger than is required for great speed, for sea-going purposes, both armed with the heaviest ordnance. Hitherto the usefulness of gun-boats seems to have been greatly limited by the inaccuracy of fire incident to their inconvenient liveliness. The cure of this evil, by means such as I have now proposed, will render such vessels most formidable antagonists, of which large numbers may be economically maintained. It is difficult to conceive that any iron-clad now known could hold her own long against a score or two of such assailants, which, although some would be soon destroyed, would keep an incessant hail of well-directed 5-ton shot on her sides, exposed to the perpendicular fire of at least some of the attacking swarm.

In order to guard against misapprehensions, I would here recapitulate the terms of my present proposal. I do *not* advise that the present Navy of England should at once be broken up and sold for old iron.

I do not even advise that any existing man-of-war should be subjected to immediate alteration. I recommend nothing sweeping or revolutionary. I simply suggest that certain contrivances by a celebrated mechanical inventor should be subjected to examination and trial, in order that it may be ascertained whether their employment will, or will not, give marked preponderance to the attack at sea, the weak point of which at present consists in the unavoidable inaccuracy of fire caused by the ship's motion. If these modern contrivances are found to remedy this weakness, and the consequence should be, as I feel sure it will, great diminution of our dependence on armour, I feel certain that all persons not directly interested in maintaining the present system will hail the change with joy, as a relief from doubt and anxiety, no less than from an almost ruinous expenditure.

I wish, in conclusion, to express the hope that, whilst endeavouring to point out a way of escape from the oppression of armour-plating, I shall not be thought ungenerously to condemn those who have created that magnificent defensive system. It is not possible to think of that system without also thinking of its principal creator, Mr. Reed; nor would it be just to speak upon it without alluding to him.

I would briefly say that I yield him most heartily the highest credit for his immense services to the country and to the science of Naval architecture. It is impossible to tell what may not have been the political effect of his exertions to keep England ahead of the world in Naval defensive power; whilst his contributions to the art of shipbuilding constitute a well-marked epoch in the progress of knowledge, the value and importance of which will still remain, though armour-clads shall become things of the past. If a change should be shown to be necessary, I fully expect that Mr. Reed will be one of the first to admit it, and one of the foremost and ablest in indicating the best modes of effecting it.

Mr. Bessemer: Colonel Strange has not gone at all into the details of the mode of suspension, I believe purposely, because those may be arranged in different ways. Any platform that supports a heavy gun must necessarily move with a certain amount of friction. There is a vis-inertiæ in the movement of those large masses involved, which in all cases will absorb a certain amount of power. There are few modes of mechanically employing the necessary power for that purpose that would not impose upon the person directing it, so much manual exertion as to prevent his having the full command of it. There is, I believe, only one way in which that can be thoroughly effected, namely, by the use of hydraulic power. Water under pressure, as you are perfectly aware, may be passed through a valve and act with a considerable amount of power without the valve through which it passes, requiring much force to put it in action: hence it becomes a very ready means of transmitting power, particularly when that power is very uncertain in the amount that is to be administered, or the quantity or the distance it has to move. In contrivances of this kind, what is called an equilibrium-valve is generally used, but the ordinary construction of the equilibrium-valve has this immense disadvantage, that as the valve rises from its seat, the pressure exerts itself upon the sides of the cone, and a new and enlarged area of action results, and consequently the valve supposed to be in equilibrium is no longer so. In order to make my apparatus extremely sensitive and capable of being moved with a very small amount of force, I have adopted what I call a knife-edge equilibrium-valve, that is a circle with a raised rim, with a fine line only in contact. The result is, when it is raised, there is no new or additional surface for the water to act upon, because

we have an equilibrium valve by which a man can at once bring to bear a pressure of from 20 to 30 tons with a movement of a handle, which perhaps requires only 3 lbs. or 4 lbs. to move it in either direction. Consequently, with so very sensitive an implement as that, he has full command over the very heavy object it is intended to move. In placing a naval gun upon a platform it may be necessary or desirable that the floor surrounding it and its slides, and the whole paraphernalia of the gun in fact, should be retained in a continuous position, while all the surrounding parts rise or lower themselves by the rolling or pitching motion of the vessel; or the power may be applied in some cases certainly for a broadside gun, by employing this power only to move the gun on its trunnions if the ordinary screw for elevation be replaced by a small hydraulic cylinder, say 3 inches in diameter, and the gun has a preponderance say of 1 ton. Now a pressure of 400 lbs. per inch on a 3-inch ram, which presents a surface of 7 inches square, would give a pressure exceeding 1 ton on the ram, and would raise the breech of the gun, whereas the letting out of the water from under the ram would allow it to fall again. So small a quantity of water has to be dealt with in that case, and so small and easily moved a valve would be required, that the operator would be able to keep his gun constantly horizontal, notwithstanding any motion that the gun carriage was subjected to, or if a certain angle of elevation be desired, that also could be maintained, so that he would keep the gun always pointed on the object notwithstanding the rolling motion of the vessel. If the apparatus has to be applied to the whole platform on which the gun stands, a larger hydraulic cylinder and ram would be required, and it would not be quite so sensitive as the smaller one, but I think sufficiently so for all practical purposes. The mode of working guns at sea is a thing which I am very little indeed acquainted with, and I should not like to give an opinion before the very many practical men I see before me. They will be able to judge better than myself how far a steady platform will be valuable on board a ship of war. That such a platform can be rendered steady under every motion of the ship I have no doubt, certainly within an extreme range of one degree of movement whatever the movement of the ship may be. I do not know that there is any other point I need touch upon, with the exception of mentioning that at a future period I should have great pleasure in laying before the members of this Institution a description of the instrument which Colonel Strange was kind enough to refer to, as also providing a means of accomplishing this desirable object, that is, of directing a gun at sea. With reference to another allusion made by the Lecturer this evening to the large guns, I can well feel that the mere mention of such a huge implement without knowing the particular means by which such a thing could possibly be practicable, must appear a sort of Baron Munchausen story to those used to the small implement we now use. But you know that in every department of the arts, almost, we have heard from time to time of these gigantic strides. It is not so many years ago since the forging of a piece of iron was done by a certain number of smiths with 40-lb. hammers, and if a dozen were required, that number were employed on a single mass of iron, as in forging an anchor. Now if somebody had told us at that time that Mr. Krupp, of Essen, proposed to use a hammer weighing 50 tons, and to strike 60 blows with it per minute, it would have appeared very preposterous, but you know that the use of a 50-ton hammer is now an every day occurrence. I feel, however, that I come before you with respect to these enormous guns very much in the position of a person who might have told you that Mr. Krupp proposed to have a 50-ton hammer when only the 40-lb. sledge hammer was known. I shall have great pleasure in giving you my views on that particular subject on a more opportune occasion. (Colonel STRANGE: May I ask Mr. Bessemer to say if I have correctly described these proposed guns?) Quite so. (The CHAIRMAN: Do we understand that Mr. Bessemer is prepared to exhibit to us the instrument which the man is to observe whilst he is manipulating the valves, because that is the most difficult point of all?) Yes, it is a very small thing; I can bring it here without difficulty. My other models are rather too large.

Commander W. DAWSON, R.N.: The title of the paper is "Proposed Method of Mounting Heavy Ordnance at Sea on the principle of the Bessemer Saloon;" but it has embraced every subject connected with the sea. It was quite unnecessary for Col. Strange to offer an apology to naval men that he, as a military officer, should come

forward on the subject of naval gunnery. Naval gunnery is the child of the army; we owe the existence of the science of naval gunnery to a distinguished soldier. To this day we have no means of educating and training naval Officers in scientific naval gunnery, though we are to have a Professor of Field Fortification at the New College at Greenwich; so that we are at this moment as much indebted to the Army for our artillery ideas as when Sir Howard Douglas took us up, 40 or 50 years ago. We are indebted to soldiers, not only for building and supplying naval guns and naval gun-carriages, but for all subsequent inspection and repair of heavy ordnance. Though the Navy is not deemed worthy of a voice in these matters, and the training in our gunnery ships does not include intellectual culture in artillery science, yet it has a good deal of rough experience in the handling of heavy ordnance. Experience without knowledge may do for an operative gunner, but such problems as Colonel Strange brings before us, call for artillery education such as the Navy is deficient in. At the same time I think a more intimate acquaintance with the practice of naval gunnery would lead Colonel Strange to modify to some extent the idea that the inaccuracy of fire is entirely or even chiefly due to the motion of the ship. There is no question on the point that shooting at sea has gone back since the introduction of rifled ordnance; that seamen cannot shoot so well now as they could in the days of the old smooth-bore; but I do not think that is caused entirely by any accession of motion in modern ironclads. On the contrary, it is because we do not realise that the change in the gun necessitates a change in the mode of using it. We require now to know the exact distance to a few yards. This knowledge of the range is all the more necessary, as our rifled ordnance, having "decidedly the lowest velocities," have necessarily the highest trajectory, and therefore make the worst shooting at unknown distances. We also require to sight our guns on some sensible system, extending the distance between the fore and rear sights to the very utmost extent. When we pay attention to these two essential points, they will be found to account for a great deal of the bad shooting in ordinary weather. The third essential, that of giving us a steadier platform, which Colonel Strange has brought before us now, is very important. At the same time we should recognise thoroughly what are the limits of the inaccuracy which is caused by an unstable platform. Of course all seamen will agree that when a ship is rolling 30° each way, hitting the object is "a miracle," as was well put by a late Admiral in command of the Channel Squadron; but I am not quite sure that seamen think 4° or 5° roll a bad thing. It is the regularity of the roll, if it be only 4° or 5°, which is of most importance. Given a very regular motion, and I am not sure that seamen do not rather like 4° or 5° roll. There is another point we must keep clearly in view, and one which I would commend to Mr. Bessemer's attention when he speaks of regulating the rolling motion by movements of the breech. That might act very fairly when pointing right abeam, but obviously when the gun is being trained a little way before or abaft the beam, the contrivance would be inaccurate; and it must be remembered that in naval gunnery the gun is always being trained to right or left to the last moment of firing. The mere pumping up and down of the breach of the gun would not therefore meet the conditions of the case, even if the gun could otherwise be aimed by its captain. As to the moveable platform, all naval gunners will acknowledge to a great gain, by the reduction of motion to a certain small limit; nay, that it would be an immense gain, if Mr. Bessemer could do that which I understand he is sanguine enough to expect to do, namely, put the gun on such a platform that the gunners would not know whether the platform was on shore or at sea. Given as immoveable a platform as a battery on shore, and there is no naval gunner who would not immediately acknowledge that he could shoot very much better. But will he give us an absolutely motionless platform? It would of course be rash for me to offer a decided opinion on the absence of all motion at the moment when Mr. Bessemer is going to try the experiment at sea with his own saloon. My own opinion at present is, however, that absolute immobility will not be realised; that is to say, that Mr. Bessemer will not realise immobility so perfectly that the platform will be as steady as though the gun were on land. (Col. Strange: An extreme range of one degree.) One degree is 500 yards of range. (Col. Strange: One degree of arc.) One degree of vertical arc is 500 yards of range in the gun. The question is, will the gunner who is captain of the gun be able to make better shooting when he has to consider the proceedings of another gunner who

is introducing an uncertain human motion, independent of the natural movements of the sea, for there will be this irregular motion of one degree going on intermittently. This artificial movement of the platform depends upon the will of a human being, who imparts an accidental motion, which the gunner who is firing the gun cannot possibly anticipate. When a well-designed ship has a steady roll of 5° or 6°, there is a certain equableness in the motion that an experienced gunner can anticipate and allow for, taking his aim accordingly. But if there be introduced, instead of that equable movement, an irregular motion depending upon the will of another individual, I question very much whether what is gained by the reduction of the arc will result in more accuracy than the 4° or 5° of steady uniform roll. That is not, perhaps, the chief objection that I myself should raise to the contrivance. Until we have some indication of the apparatus and machinery, it is very difficult to form an idea of the structural difficulties which the naval architect will have to contend with, and therefore as to what it would cost, not in money, but in space and weight. One of the most pressing naval subjects is the re-armament of the present fleet rather than the building of a new one. It is not at all creditable or right that any one of our iron-clads should meet any hostile ship and not be able to pound her, simply because the guns carried are too weak to perforate the armoured side of the enemy. We want, therefore, a re-armament of the fleet, so that every ironclad, whatever the thickness of her own armour, should carry guns capable of perforating the armour of any hostile vessel she came across—guns which have not "decidedly the lowest velocities," nor "decidedly the least penetrating power." Will the Bessemer apparatus for suspending gun-platforms be so heavy and occupy so much space that it will militate against the embarkation of heavier guns in existing ships? These and the structural difficulties are practical questions that should be determined before forming an opinion as to the cost of the contrivance in extra weight, space, and architectural devices.* Whilst ready to acknowledge that increased accuracy would ensue from greater stability of platform, which did not vitiate uniformity of roll, I am not quite sure that the amount of gain to the art of shooting would be very great if an irregular motion, dependent on the will of another man, were substituted; and if the gain to the marksman is not very great, then the question is governed by considerations of weight, of loss of space, and of architectural difficulties. If the artillerist gains little from the Bessemer gun-platform, what does the architect lose by it? These are practical questions which we ought to keep in sight, and I venture to recall Colonel Strange's attention to a letter which appeared in the *Times*, in answer to himself, signed "P. H. C." It was one of the best replies I have seen in that correspondence, and the initials are those of a distinguished naval gunner, whose name would have added weight to his opinions. "P. H. C." pointed out what were the real difficulties of artillery fire at sea; and also the fallacy of contrasting the action of many small vessels with that of one large ship, in a naval combat. The ideas put forward in that letter quite correspond with my own, and I commend them again to the Lecturer's attention.

Capt. Selwyn, R.N.: I desire to say a few words on this question. I am quite sure my friend Colonel Strange came here honestly to ask an opinion, and that he would be most dissatisfied if the discussion was not a full one. With regard to the question he has placed before us of a stable gun platform at sea, there is first to be recollected that those are in error who assume that a ship's motion can be recorded in two planes. This is entirely inaccurate. The ship has six different motions: first, rolling; second, pitching; third, rising on the uplifting wave; fourth, falling; fifth, swaying to the starboard; and sixth, swaying to port. No ship, even our best steering ships, of which we do not rejoice in many to-day, ever did move through the water with her head constantly on one point of the compass. These introduce a most complex set of geometrical curves. You cannot compensate by any possibility for these movements by considering them as acting through only two planes; and I

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* If the gun-platform be anything like the diagram of the Bessemer saloon, exhibited at the Society of Arts, 5th February, 1873, the architectural difficulties, to enable the gun to point at an external object from a rolling ship, would be immense. —W.D.

think that this is a difficulty which should be thoroughly estimated. However it may seem not to have its value in the moderate seas commonly seen in crossing the channel, it is certain to have its value whenever you get into the deep long swell of the Atlantic, where we must come to decide our naval battles sooner or later, if we are ever to decide them. Next I draw attention to another difficulty which appears also to have its value and weight. I should be very loath indeed to fancy for a single instant that a gentleman whose magic touch has turned all our iron into steel would be unable to cope with any mechanical difficulty, but there are physical difficulties which only those who live on the ocean can appreciate thoroughly, and seamen are therefore bound to state them. In a ship in which you establish a stable platform for guns, in some portion of her you have to choose between two difficulties, you must either have that stable platform on the upper deck, with the sight from it entirely uninterrupted by surrounding objects, and therefore devoid of armour or any such contrivance; or you must have it below the broadside, armoured or not, as you please, but still having a hole through which the gun must point. If we adopt simply the platform *per se,* we have no great difficulty to leeward so long as the platform is on the upper deck; we have very great difficulty to windward, because the instant we attempt to point a gun in that direction the muzzle of the gun dips below the weather bulwark as the platform keeps its horizontality during the lee lurch, and you could not fire at all without firing through your own ship. Below, a similar case occurs. You must either unduly extend the vertical height above and depth below, of your port, in order to enable the sight to be obtained if the gun itself is on a moving platform, or in the case where the trunnions are the axis of rotation, you must also, though in a lesser degree, provide for the vertical elongation of the port. Under these circumstances, not only will the objections occur, which Captain Dawson has stated, but there will be the further objection that the gunner's eye must be moved to follow the breech of the gun rising and falling, which is most inconvenient, he must be alternately stooping down exceedingly low and rising excessively high, he is in no fixed position, and that position which he has to assume is dependent on the will of another person. These are all difficulties in the way of those things being properly carried out. I do not anticipate any great difficulty, knowing the use of the Rev. Mr. Berthon's log, by which the pressure due to velocity near the bottom of a vessel is recorded as the rate of speed in the cabin by an apparatus for the purpose. There is no practical difficulty in getting a level with water in tubes covered with oil in any vessel, provided the distance apart of the tubes be sufficiently great. But there is a very great difficulty, and one which I do not think we shall easily overcome, if all these contrivances are to be applied to a cupola. I assume we are still to have some armour if the platform is on the upper deck, because I confess I cannot see my way to fighting any action whatever with any sized guns in modern days without some description of armour. I am sorry to say even ironclads are not exempt from the liability to be set on fire. We do know the use of molten iron. I have fired a great many red hot shot myself, and I know what effects they have. I know also that modern projectiles are of such a destructive character that practically an absolutely undefended gun is an unworkable and unfightable one; no man can stand by it under modern fire. If even the large guns failed of their effect, the accuracy of small arms is quite sufficient to make it impossible to work them within such distance as I hope Britons will always seek at sea. I am not one of those who believe in shooting mosquitoes five miles off, or even ironclad ships. The problematical effect of the shot, which has been already adverted to as being extremely great on account of inaccuracy of fire, is more than doubled or trebled, it is centupled in uncertainty the instant you do not know whether your shot has missed or hit, which you never do at the very long ranges; you hope it has done something, and that is all. I am not one of those who believe that actions can ever be decided in that way. With regard to the question of stability of platform as derived from the form of the ship, I say the late Mr. Elder unmistakeably showed in this theatre that there was no difficulty whatever in obtaining a perfectly stable platform at sea—except as to the inclination of the wave, which we shall never overcome—as stable as a raft; that with that he combined a ship of the very greatest speed, the very greatest capacity, capable of carrying armour 6 feet thick if you like, if any such thing were desirable at all. You have only to increase the width of your

ship and you may increase the thickness of the armour without great increase of weight, because it only occurs at the edge of the ship, so to speak. Add to that Major Moncrieff's mode of carrying the guns below, and you have a ship which you cannot very easily attack, except by that modern enemy of seamen, the torpedo. There I confess, as far as I have been able to form any judgment myself, we are utterly and totally at a loss. If the torpedo should be guided with anything like the skill which has been shown in guiding all other weapons, these and all other floating vessels are attackable in a way against which they have at present no defence whatever. Cellular bottoms and everything else disappear at a touch when the torpedo explodes fairly under you. With Mr. Bessemer's platform I should say there is no difficulty whatever in doing some things for some persons, that is to say, I have no doubt whatever he will keep his platforms horizontal on board the vessels to which he proposes now to apply them. I am quite sure he is perfectly capable of doing that. Whether those who, I am sorry to say, get sick at the very sight of the sea will thereby be enabled to withstand the influences of the Channel, I do not know. I believe there are some stomachs so sensitive that not even the assurance that they are on shore secures them from sea sickness, but it will be a very great advantage to those who really suffer not from imagination, but facts, and I hope he will succeed in carrying it into effect. We shall derive very much instruction from seeing what he does in that way. Until then I think we may suspend our judgment as to what can be done at sea for gun platforms. With regard to the question of armoured *versus* unarmoured ships, I have in this and in other theatres constantly advocated the gunboat as opposed to the big basket in which you put all your eggs. I have said, over and over again, that the proper utilization of the naval reserve is in gunboats owned almost, so to speak, by the ports from which they proceed and to which the seamen belong. I believe that these will constitute the the truest defence of our coast. As regards doing away with armour for them, I am afraid they cannot carry any armour, but there is a safety in insignificance, and as long as you make your gunboat as small as she ought to be to carry the gun and do nothing else, not trying to make her a sort of hybrid cruiser at sea—a hybrid carrier of men to distant climes, where they roast in such a vessel in the torrid zone and freeze in the frigid—as long as you will be content to do one thing at a time, and not make a hundred bladed knife in which no one of the many blades can be used satisfactorily, you will get an object not easy to hit, and therefore not requiring armour so much, and you will get a thoroughly good gunboat for the defence of your coast. You may then turn your attention, if you will, to an unarmoured cruiser, to carry our flag over the world. In war I do not think such cruisers would be of any importance. I am sorry to say a change in our navigation laws has rendered it extremely doubtful whether the day after war is declared with the most insignificant nation of the earth by England, a single merchant vessel would remain under our flag to be protected. The insurance offices in the City take no note whatever of anything else but money risk, and the day they tell the merchants of England " we shall charge so much more insurance as " war risk on your vessel as long as she sails under the English flag," that day, by the result of the new navigation laws, commerce deserts your flag, as it did the American, and unfortunately it seldom returns when war has ceased. Wise legislation can do a great deal that neither soldiers nor sailors are able to effect. If that wise legislation is wanting, it is in vain to ask us to fill gaps with the sword which have been made by the pen. Still less can we hope to recover a naval prestige once lost, while other nations are pressing around us every day seeking to snatch from us all that we hold. It is not now a time for us to say all that we think about the efficacy of armoured ships. We hope to see wiser councils prevail. We hope to see careful experiments made before millions are wasted; but investigation alone can determine this, and such investigation ought not, as the Lecturer has so well remarked, be made a political rather than a scientific question.

Colonel Strange: I need make but very few remarks in reply to the observations which Captain Dawson and Captain Selwyn have been kind enough to make upon my paper. I am very glad indeed that Mr. Bessemer has made a few remarks, as they have given us a great deal of instruction. Captain Dawson laid great stress upon, what is no doubt the fact, that the gunner of the future, perched upon a Bessemer platform, will not be able to use the same devices as the gunner of the

present. I said that myself in my paper. This contrivance certainly should not be tested by attempting to combine with it existing methods. I went so far in my paper as to say, that I think it would probably lead, if it were introduced, to something of a revolution in naval gunnery; therefore I quite concur in Captain Dawson's objection that there would be a difficulty to overcome. But Captain Dawson very candidly admitted that although naval gunners at present find it convenient to have a little roll, they probably would shoot better still if there were no roll at all. I think he admitted that. Well now, the fact that they do so much enjoy this little roll is—I say it with all respect—in consequence of the defect of existing arrangements. They fire well in spite of the roll, not because of the roll. I cannot for one moment admit that they fire even as well as they do, because the ship rolls. Be pleased to follow me logically. If they fire well because the ship rolls, then we are driven to some curious consequences. Captain Dawson reminded me of a letter that appeared in the *Times* under the initials of "P. H. C.," in which the very same view he has expressed was taken, and although Captain Dawson says that letter was written by a very distinguished naval Officer, I must still venture to say I do not quite follow his reasoning. The stability of a gun's platform must either be desirable or undesirable. I cannot see how it can be both, and I hardly can conceive how it can be neither. It must be desirable or undesirable. If desirable, let us press that view of the matter to its legitimate consequences. The Royal Artillery should make their gun carriages roll. And, to go a little further, and apply the same principle to a different matter—astronomy is only another kind of gunnery—a kind of cruising—surely if this rolling is beneficial, the best thing for the Astronomer Royal to do would be to put his big telescopes on rockers, and work them with a donkey-engine. The doctrine seems to me, if pressed fairly to its legitimate consequences, to lead to conclusions which are almost an absurdity. But there is truth in what Captain Dawson says, that much depends upon the kind of roll; but that was not the view of the matter taken by the writer of the letter in the *Times*, who simply advocated motion. What Captain Dawson says has, I think, some weight, that the platform will not be absolutely motionless. Mr. Bessemer considers he can obtain horizontality varying only in the extreme, one degree. When you talk of the extreme variation being one degree, you mean of course that the average, the general variation, will be a good deal less; you are not always at extremes. Therefore we may suppose that, if Mr. Bessemer succeeds in doing what he thinks he can do, the gunner will have the advantage of a platform varying in its angular movements considerably less than one degree. Now that approaches, for practical purposes, so nearly to absolute stability, that for my part I feel inclined to take it as absolute stability. Whether that can be done or not of course I do not pretend to say positively of my own knowledge; I merely know that a gentleman who has devoted a great deal of attention to the subject thinks it can, and you will notice throughout my paper that I do not say positively that these things will be done, but what I positively do say is, that we ought to know whether they can be done or not, if the doing of them will lead to any advantage. Now I think Captain Dawson himself admits that if practical stability of platform is attainable, there will be great advantage, but you have still to prove that it is attainable—you have still to prove that you will thereby very greatly increase the accuracy of fire, and that in attaining this great increase of accuracy, you do not sacrifice some essential matter. Captain Selwyn and Captain Dawson, as practical seamen, have pointed out that there may be inconveniences—that the internal arrangements of the ship and so on may be disturbed by this contrivance; those are points to be brought out only by trial: the question is, is it worth trying? That is the immediate question I wish to raise in my paper. I am not aware that there is any further remark by Captain Dawson that requires reply. Captain Selwyn has adverted to a great many subjects, and the first was the subject of the six different motions. I took down the motions from his lips as he enumerated them, and they are really four: "rolling, pitching, rising, falling, and throwing her head about." Now rising and falling are the same (Captain SELWYN dissented); just as pitching is compounded of two angular motions; a ship in pitching rises and falls, but still you call those two motions pitching; and so rising and falling are the same kind of motion. I do not mean to say when a man jumps on a table that is the same thing as when he jumps under

the table, but he exerts himself in the same plane. Therefore, rising and falling are, speaking mathematically, one motion. Then, "throwing her head about;" now that is a lateral motion. I maintain that suspension in two perpendicular planes will preserve the horizontality of the body so suspended under all conditions. Here (showing a binnacle compass) we have a body so suspended. There is the rolling. I think Captain Selwyn admits that that motion can be counteracted by the suspension, and there is the pitching. Now how are either of those suspensions vitiated by any raising and lowering the box? (Captain SELWYN: We are speaking of pointing guns at external objects.) Certainly. We will come to that. The horizontality I maintain is the same, though the body rises and falls; but this up and down motion of which so much has been said, which is supposed to disturb the stomach, as we all fancy it does, is a motion that has yet not been fully investigated. I think common sense will tell you that its amount must vary with the size of the waves and the size of the ship. For instance, if you stand in a dock where there is a slight ripple, and watch bits of straw and cork and so on floating about, you will see the cork at one moment on the top of the ripple, and at another moment at the bottom, rising and falling the total height of the wave or ripple. But a great merchantman lying there would be absolutely motionless, the motion of the water, though acting very perceptibly on the cork, would be quite insufficient to make her rise and fall at all: therefore it is evident that that motion is dependent on the size of the wave as related to the size of the ship, and the larger the ship, other things being equal, the smaller will be the motion. I have not met with anybody yet who has determined the amount of this motion, and I shall be very glad if Captain Selwyn can tell me if a measure of that motion has ever been made. I am inclined to think not. I am inclined to think it has been so difficult to eliminate the other motions with which it may be confounded, that no measure has ever been obtained of that particular motion, namely, the motion of vertical translation. I still maintain that with the gun mounted in the ordinary way, you are subject to angular deviation, whilst with the gun mounted in Mr. Bessemer's way, you are subject to linear differences, and they are totally different. Therefore, I dismiss the rise and fall, because they amount to a quantity that is small compared with what you may expect from any kind of gunnery at sea at present. As for the side motion, that would have no influence upon the horizontality, which is the main point. Then Captain Selwyn spoke of the impossibility of firing guns to windward on account of the obstruction of the ship's side. Of course it would not do for a man to shoot through his own ship, but I was not alluding to guns shooting athwart ships. (Captain SELWYN: Just the same.) I deal in my paper with end-on fire. A gun in the bow has nothing to fear from the sides of the ship: it is clear of all obstructions. I advocate this contrivance of Mr. Bessemer's as peculiarly adapted to bow guns. I have said so in my paper, and of course with a bow gun you are not exposed to any obstruction whatever. If it is necessary to use the gun athwart ships, then either the ship must be made to suit those conditions, or you must wait till the roll takes place, and you can clear the side, or not shoot at all. Then Captain Selwyn said it would be very inconvenient for the gunner who might be supposed to be on the fixed part of the ship to rise and stoop to take aim, but I am supposing a state of things where people have not got to take aim. The gun fires itself if necessary, and dispenses altogether with aiming. I have particularly stated in my paper that Mr. Bessemer has a contrivance, which he has been kind enough to show me, and I think I have not incorrectly said that contrivance will enable the gun to fire itself, when it arrives at the inclination due to the distance of the object fired at. (Captain SELWYN: Are we to understand when the object is changed or merely when it is horizontal?) When it is horizontal. Of course this contrivance is not endowed with optical powers, but something very near it. Captain Selwyn has referred to Mr. Elder, of whose communication I did not know, who he says has solved the question of stability of platform as derived from the external form of the ship. I have before me an official document drawn up by some of the most distinguished seamen, engineers, and mathematicians of England, which goes to say that hitherto, that is up to 1871, those two things, namely steadiness of platform and stability or safety, had not been reconciled by means of external form. If they have since been, I am very glad indeed to hear it. Torpedoes, Captain Selwyn

admits, are irresistible, and I am very happy to hear from him,—for though we differ on some points, I have the greatest respect for his opinion as I have for himself,—that he is favourable to a great development of gunboats. Of course it is difficult to foresee what may be the result of new improvements, but it seems to me that this is the direction, that this contrivance is likely to be first employed in the perfecting of gunboats, and if it does that, it will have done a great deal. I have fallen foul of armour because I am not at all singular in feeling that armour has placed us in great difficulties; but unquestionably there were strong reasons for having recourse to it, and having recourse to it was quite justifiable at the time. But as we are advancing in knowledge and power, we have to revise arrangements which formerly were thought very judicious, and I think in the words of the report of the Committee on Naval Designs, and as I say in my paper, quoting the opinion of the most distinguished authorities composing that Committee, "the time is approaching when the superiority of the gun will be final and definitive."

The Chairman: If the discussion on the paper has been rather discursive, perhaps it is owing to the fact that the subject was so entirely new, and that the paper itself took a rather wide range. Colonel Strange perhaps, as a scientific man, has looked further forward than any of us were prepared to join him in looking forward, and we as practical men have been rather anxious for those postulates about which he spoke. Captain Dawson said, and many naval men will agree with him, that we rather prefer a slight roll at sea to having no roll at all. I think I may venture to add another explanation to that, viz., that what we like is, that when there is any roll at all, it should be a roll with a certain amount of amplitude rather than a short one; that what we do *not* like is, that the ship should take a slight inclination of about three degrees, then oscillate backwards and forwards over one degree; then take a roll in the opposite direction of three degrees, and oscillate backwards and forwards one degree. That is what we do *not* like, because we rarely cover our object; but what we *do* like is, that we should roll steadily and gradually through three or four degrees, so that we should be repeatedly covering our objects and having repeated opportunities of fire. Then again, I must say I think Colonel Strange has convinced us that the rolling and pitching are the only two movements which have to be made up for by such a platform. There is the movement of rising and falling, and the movement of translation. The movement of translation will very largely affect any instrument which has hitherto been constructed (except that of Professor Smythe) to guide the eye and judgment of the man whose hand guides the movement of the platform. Any instrument hitherto constructed, except that of Professor Smythe, will always partake of the inequality of the platform to the wave surface. Mr. Froude is going to read a paper on the subject shortly, so that I will not allude further to it.

I have now to ask you to return your thanks to Colonel Strange.

Evening Meeting.

Monday, April 7th, 1873.

Rear-Admiral Sir ASTLEY COOPER KEY, K.C.B., F.R.S., in the Chair.

NAMES of MEMBERS who joined the Institution between the 7th and 21st April, 1873.

LIFE.

Littledale, H. W. A., Lieutenant, R.N.
Jocelyn, W. H., Lieutenant, R.N.

NNUAL.

Abbott, Saunders A., Major-General, late Bombay Army.
Bouverie, Henry H. P., Lieut. W. Som set Yeomanry Cavalry.
Barnett, Henry, Lieut.-Colonel, Oxford Yeomanry Cavalry.
McPherson, Cecil, Capt., 17th Regt.
Burr, C. E. G., Lieut., 17th Regiment.
Shepherd, Henry, Captain, 2nd Kent rtillery Volunteers.
Simpson, Frank, Staff Surgeon.
Todd, J. A., Lieutenant-Colonel, late 14th Hussars.
Macpherson, J. C., Captain, R.E.

APPARATUS FOR AUTOMATICALLY RECORDING THE ROLLING OF A SHIP IN A SEA-WAY, AND THE CONTEMPORANEOUS WAVE-SLOPES.

By William Froude, Esq., M.A., F.R.S.

I propose to explain an automatic instrument I have made for recording some of the more important phenomena connected with the rolling of ships at sea. In order to explain the objects for which it is necessary that these phenomena should be recorded, it will be desirable that I should set forth in outline, some of the leading principles on which the rolling of ships depends. I would mention, however, at the outset, that the record given by the more special portion of this apparatus depends for its accuracy on simple mechanical principles, and is in no way dependent on the correctness of any theoretical assumption, yet its operation, as a whole, is specially relevant to the principles referred to, and its records will be specially suitable for testing the theory to which the principles seem to point. I need scarcely observe that the determination of the causes of the rolling of ships is an important and essential step towards the discovery of remedies for the evil.

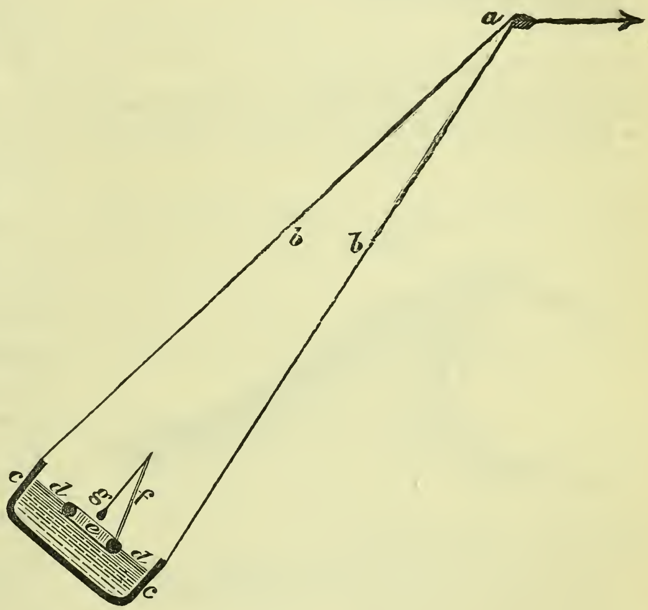
In considering the rolling of ships, the primary question is, why does the passage of a wave cause the ship to roll? In what precise manner does the peculiar deformation of the surface of water called a wave, impress rolling motion upon a ship?

To consider, in detail, the various actions of each portion of the wave-

water, would involve complication ; but these all resolve themselves into a total which is very simply expressed by the proposition that the ship tries to place itself upright to the slope of the wave, for the same reason and with the same energy as she tries to place herself upright to the level surface of smooth water. This may at first sight seem a little paradoxical; but it sounds more reasonable when it is suggested that the ship desires to place herself in this sloping position on the slope of a wave, in obedience to substantially the same set of conditions as those which cause the water itself to assume this sloping position. In fact it correctly expresses the effect of waves on bodies floating upon them, to say, that the apparent direction of the force of gravity, is square to the surface of the wave. This apparent alteration of the vertical direction of gravity, which causes the water to stand temporarily sloping instead of level, and causes bodies floating on its surface to try to become perpendicular to this slope instead of truly vertical, is due to the translatory sideways accelerations involved in the motion of the particles of which the wave consists.

This effect may be illustrated by a plumb-line. If its point of attachment is stationary, the plumb-line will hang vertically, but if the attachment be accelerated sideways, the plumb-line will hang askew as long as the acceleration is continued, the direction of the suspending line indicating what I have termed the apparent direction of gravity at the plumb-bob. If, for the plumb-bob, a cup of water is substituted, it will be seen that the surface of the water in it will be always square to this apparent direction of gravity, and the slope thus impressed on the water, is closely analogous to the sloping surface of the wave. For just as the acceleration sideways of the particles of water in the cup, causes the surface of the water in the cup to be sloping, so the acceleration sideways of the particles of water forming a

FIG 1.—EXPERIMENT OF FLOAT IN SUSPENDED CUP.

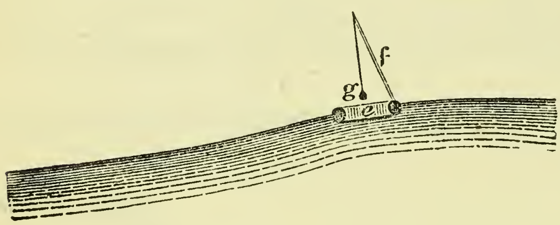


a. Point of suspension being accelerated sideways from left to right.
b. Suspending lines.
c. Cup.
d. Surface of water in cup perpendicular to the line of suspension, or the apparent direction of gravity.
e. Float in the water.
f. Short mast in the float carrying
g. A small plumb-bob which hangs in conformity with the apparent direction of gravity, and thus at right angles to the surface of the water.

wave, causes the surface of the wave to be sloping. And the analogy may be carried further, by placing on the water in the cup, a float having a small mast from which a plumb-bob hangs; then when the cup is swung about as before, not only does the water in the cup stand perpendicular to the line of suspension, but the float continues upright to the surface of the water, as also does the plumb-line hanging within it (see Fig. 1). In trying this experiment it is essential that the float should be very stable and the plumb-bob one of "short period," so that they should instantaneously assume the varying inclinations impressed on them by the varying external forces we are examining.

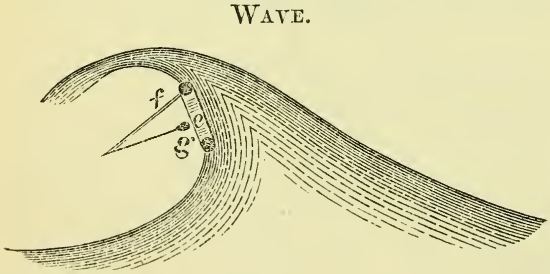
This proposition that the apparent direction of gravity is square to the surface of the water, which thus simply and directly describes the origin of the rocking forces administered to a ship by the waves, is shown by the above experiment to be true of the water in the suspended vessel. That it also holds good in the case of a body floating on waves is demonstrable by theory, and I have also shown it by an experiment with the float and plumb-line. In this case the float consisted of a cork ring like a life-buoy, about four inches in diameter, and was placed among waves of various form (see Fig. 2). In one case I placed it in waves breaking on a beach, and I could see it on, or rather under, the overhanging crest of a breaking wave, and even in this case the plumb-line was pointing rigorously square to the surface of the water, although that surface was actually facing downwards (see Fig. 3).

Fig. 2.—Experiment of Float in Waves.



e. Float made of a cork ring.
f. Short mast in the float carrying.
g. A small plumb-bob which hangs in conformity with the apparent direction of gravity, and thus at right angles to the surface of the water.

Fig. 3.—Experiment of Float in Breaking Wave.



e. Float made of a cork ring.
f. Short mast in the float, carrying
g. A small plumb-bob which hangs in conformity with the apparent direction of gravity, and thus at right angles to the surface of the water.

The condition of things, then, under which it happens that a ship is set in rolling motion, and from which she derives that motion, when floating in wave-disturbed water, as contrasted with that under which she remains at rest in undisturbed water, is the fact, that, whereas in still water, the attitude into which the pressure of the water perpetually tends to force her, is constant and unchanging, in wave-water, on the contrary, this altitude is continually varying. It is in the constantly defeated attempt to attain the attitude of rest, that the ship among waves is perpetually changing her attitude; and since this attitude is

the ship's position of momentary equilibrium, that is to say, her right position for the moment; and since it is the fact that when she deviates from it by a given amount, the force which urges her towards it, is the same as that which tends to right her, when similarly inclined in still water, it may be conveniently termed a righting force, and I shall speak of it thus, even though it may be occasionally urging the ship into an inclined position, as it must do when she is more upright than if at right angles to the wave slope.

Were the ship perfectly rapid in her movements, if, that is to say, she possessed an infinitely powerful righting force when inclined in still water, or were her moment of inertia (that is to say her momentum as a fly-wheel) infinitely reduced, she would then at once attain this attitude of rest, not by being stationary, but by keeping pace precisely with the changing inclinations of the wave slope. But inasmuch as the force which urges her is necessarily finite, and her moment of inertia necessarily considerable, she is always involved in adventitious and additional movements, sometimes overrunning, sometimes falling short of the position she is seeking; and thus instead of following the motions of the waves like a raft, or, like the experimental floats, the ship "rolls."

The principle, then, out of which the rolling motion is developed, is profoundly simple; it is certain that it exists and must operate. It is what Herschel has called a "vera causa." Whether its operation is sufficient to account for and explain the rolling which a given ship will undergo when exposed to a given wave—whether in fact it is only a collateral cause, not *the* cause of the rolling, is a question which can only be answered by counting up its proper effects by the known laws of dynamics, and comparing them with the results which actually ensue.

It will be said that out of the multitudinous and confused inclinations which the surface of the sea presents, it is impossible to evoke order and uniformity enough to render the case amenable to treatment by ordinary mathematical processes. And this is undoubtedly true to a considerable extent, though to a less extent than might be *primâ facie* supposed.

It is true that we cannot by any method, mathematical or other, predict, when a ship is despatched on a given voyage, precisely how much rolling she will experience, partly because we cannot predict what seas she will encounter; partly also because no doubt the seas she does encounter will be of such unknown irregularity, that we cannot hope to appreciate their absolute effects.

But this difficulty is at least a conclusive answer to those who, without having even a definite *locus standi* as a basis of thought, who, even discountenancing the existence of such a *locus standi*, are yet ready to advance definite and confident predictions about the behaviour of individual ships.

I do not advert to men of large and varied experience, who attempt cautiously to educe rules, by induction, from the facts which their experience has supplied to them. Yet even to them I would appeal not to rely in this case with too confident preference on conclusions which

experience, taken alone, and unguided by established laws, may seem to them to have justified.

For, confidence in conclusions which such experience induces men to form, is nowhere so ill-placed as where the surroundings of the question are multitudinous and complex; since in such cases it is almost impossible to select with certainty, by experience unenlightened by theory, which out of those surroundings is the real governing condition of the problem. And on this ground I invite even those whose experience may have least inclined them to agree with me, to join me in tracing from the *vera causa* which I have explained, the consequences which, with a very near approach to exactness, must follow from it, by applying to it the known laws of dynamics and the known laws of wave motion.

Our problem is this. Given the rate at which the wave on which the ship rests, broadside on, changes its inclination *in transitu*, and given the rate at which the ship will change her inclination when exposed to a righting or inclining force of given magnitude, what will be the rate of change and the total amount of motion which will ensue as wave after wave passes under her?

In the first place, the laws which govern the motion of regularly formed waves, are now very well known, and are reducible into tractable mathematical expressions.

The rate, in terms of time, at which the slope of a wave *in transitu* varies, is almost exactly the same as that at which the inclination of an ordinary pendulum varies—quite nearly enough to be used in the investigation of this problem.

The rate, in terms of time, at which the ship will change her position, also admits of being exactly calculated, given her form and the disposition of her weights on the one hand, and the actual force on the other.

This branch of the problem, however, is perhaps best elucidated by tracing the actions on which it depends as exhibited by a ship when set oscillating in still water.

Let us suppose the ship to be hove down artificially to the successive inclinations, ${}_1\theta$ ${}_2\theta$ ${}_3\theta$, &c., by means of a succession of inclining forces acting on a lever of given length, and that the successive forces employed are ${}_1F$ ${}_2F$ ${}_3F$, &c. Now if on a base line we mark off a series of spaces which, dating from the same zero point, represent to scale the successive inclinations, and plant at the end of each, an ordinate which represents to scale the corresponding force, the tops of the ordinates, in effect, constitute a line which is called the "curve of stability."

This curve represents in fact the variation of the righting or inclining force in terms of the inclination, and it inevitably follows from the principles on which the stability depends, that up to some considerable inclination the righting force is exactly proportioned to the inclination, and for the purposes of the present explanation it will be assumed that this law holds good up to any inclination that the ship can in fact reach. The assumption involves so little error under ordinary circumstances, that the results deduced by help of it may be regarded as typical.

Such then is the force which, in still water, tends to right a ship

when she is forcibly inclined. It has here been viewed as a simple fact determined by an experiment performed on the ship herself; but it may also be arrived at by calculations based on the ship's form and the distribution of her weights, and may be expressed in terms of the elementary conditions inherent in the ship's form and displacement, namely, her weight, and her metacentric height, that is to say, the distance between her metacentric and her centre of gravity.* We have next to see what are the rotational motions which this rotational force will impose on the ship under the various conditions under which it is free to operate, excluding for the present the collateral action of what is commonly termed "the resistance of the water," and we will consider these motions first, as they are exhibited and measured by the ship's behaviour in still water.

When the ship after having been hove down, as described in still water, is released and thus allowed to right herself, the rate at which she will do so is proportioned, directly, to the righting force at the instant, and inversely, to her moment of inertia, that is to say, her momentum regarding her as a fly-wheel; and she will proceed thus with accelerated speed till she reaches the upright position (which she will pass through with a maximum velocity), and travel onwards with retarded speed till she reaches an inclination opposite to that from which she departed, and indeed equal to it but for the surface-friction, keel-resistance, &c., she has encountered *in transitu*, and which for the present, as has been said, it will be convenient to treat as non-existent. Thus she will continue to oscillate like a frictionless pendulum.

The time expended in the complete transit will clearly be the greater for a given total arc traversed, in proportion as the force employed is weaker, and the moment of inertia is greater. But if we compare the times expended in the transit by a given ship, according as the arcs are large or small, the condition that the righting force is directly proportioned to the inclination, shows at once that the time will be the same whether the arc is large or small, because in traversing the larger arc, both the acceleration and the accumulated velocity will be greater exactly in proportion as the space to be traversed is greater.

This is in fact the essential condition of isochronism in oscillation, and in virtue of this it happens that with a given ship, as with an ordinary pendulum of given length, the time occupied in performing a given complete oscillation or single swing, is within practical limits the same, whether the arc of oscillation be large or small. It is here convenient to observe that the time occupied by a double oscillation is called the "period," because it virtually completes the circuit, bringing the oscillating body back to the position and conditions from which it took its departure; and the "period" is perhaps to be regarded as the fundamental or standard unit of designation in most investigations allied to this; but as the half-period, or time of a single swing, appears to

* This is commonly formulated as follows:—$F = WM.\theta$, where F is the force, supposed to act with an unit of leverage, W the ship's weight, M her metacentric height, and θ the inclination.

me a more convenient unit in this particular investigation, I adopt it in preference, calling it the "time of oscillation."

It is easy to see that the rate of acceleration at any instant under a given righting force is completely expressible for a given ship in terms of her half period or "time of oscillation." And it is convenient to express it thus, because the time of oscillation is, *per se*, simply determinable by oscillating the ship in still water; though it must be added, that like the righting forces in still water, it may also be arrived at by the somewhat lengthy and laborious calculations* necessary for determining her curve of stability, and her moment of inertia, from the distribution of her weights.

Thus, then, as by inclining the ship forcibly in still water we may measure absolutely the force which at any given inclination urges her towards the upright position, we may by observing her time of oscillation when allowed to oscillate in still water, learn exactly at what rate she will acquire rotational velocity in any direction in terms of the rotational force which at the instant urges her in that direction; and we may proceed to import these considerations into the study of her behaviour when acted on by waves. I will again observe that the operation of resistance is still excluded from the enquiry.

Now in virtue of principles which have been already explained, the ship having for an instant a given inclination relative to the wave slope, will experience the same righting force tending to destroy that inclination, as she experiences when in still water she has the same inclination absolutely, or with reference to the horizon. And hence the rate and the direction of the acceleration which she experiences will be the same in both cases, in terms of the inclination to which it is due; and as the inclination relatively to the wave slope is the difference between the ship's absolute inclination and the slope of the wave, we are able to express the acceleration† at each instant, in very simple

* Assuming the moment of inertia and metacentric height to have been determined by the calculations referred to, then calling the time of oscillation T, the radius of gyration ρ, the metacentric height, as before, M, and the force of gravity, g, the formula for T is $\mathrm{T} = \frac{\pi\rho}{\sqrt{g\mathrm{M}}}$; but T may have been simply determined by the still water experiment, as described, and this result is *per se* available.

In any case, by the laws of isochronous oscillation, the equation of angular acceleration in still water is $-\frac{d^2\theta}{dt^2} = \frac{\pi^2}{\mathrm{T}^2}\theta$, θ being the inclination at the instant. The negative sign of the differential corresponds with the circumstance that the acceleration is always tending to diminish θ.

† The equation of angular acceleration for the ship broadside to the waves is thus $-\frac{d^2\theta}{dt^2} = \frac{\pi^2}{\mathrm{T}^2}(\theta - \theta')$, θ' being the inclination of the wave slope at the instant. Now, the wave curve may, with close approximation to truth, be regarded as a curve of sines, if we take the height to be as small compared with its length as it usually is in large waves; and under these conditions, if Θ' be the inclination of the steepest part of the wave slope, and $'\mathrm{T}$ the half period of the wave, it follows that approximately $\theta' = \Theta' \sin\frac{\pi t}{'\mathrm{T}}$, so that the complete equation is $-\frac{d^2\theta}{dt^2} = \frac{\pi^2}{\mathrm{T}^2}\left(\theta - \Theta' \sin\frac{\pi t}{'\mathrm{T}}\right)$

The integration is somewhat lengthy, nor need it or its results be formally given here. The object of giving the fundamental equation is simply to show in complete

terms, since, as has been pointed out, the slope of the wave at each instant is easily expressible in terms of time.

The working out of the conditions tells us what will be the ship's inclination and angular velocity at any future instant, given the steepness of the waves and the ratio of their period to the period of the ship, and given her inclination, her angular velocity, and her position on the wave, at the instant from which the lapse of time is counted.

The simplest form to which the solution can be reduced, arises under the limiting conditions that at this point of departure the ship is stationary and upright, and is either at the crest or hollow of the wave when the slope is zero ; and the results of this form of the solution will be taken as typical, and their principal features will be presently traced.

It is, however, instructive and perhaps necessary, to explain that if the solution is taken without any limiting conditions (namely, on the assumption that the ship when started at the zero point of wave-slope, possessed any assignable inclination and angular velocity), the completely general results that it presents are connected by a very simple and interesting relation with those obtained under the simpler form of solution. For, the ship's initial inclination and angular velocity at the level starting point may be regarded as, potentially, part of a definite oscillation, which, if continued independently in still water, would have assigned to her a definite inclination and angular velocity at every future instant. Now the interesting aspect of the general solution which I refer to is this: the prospective movements which it assigns to the ship are the same as we should arrive at by combining those which are potentially due at each instant to the equivalent still water oscillation, with those due to the operation of the wave series under the operation of the limiting conditions which give rise to the simple form of the solution. The total result at any future instant consists of that which the wave-slopes would have imposed on the ship independently of her initial inclination or velocity, added to that which the initial inclination and velocity would have imposed on her in still water or independently of any wave-slope, hence it is sufficient to regard the results of the simple form of the solution as typical.

The principal results arrived at are entirely common-sense in their character, and such as may be readily apprehended by any mind well trained in dynamical reasoning.

The most striking and the most important of them is the conclusion that when the waves which act on the ship, have the same period as the ship herself, the range of her oscillation will receive an increment of definite and constant magnitude, wave by wave, so that in the transit of a few waves she must be infallibly overset. I have myself produced this result by artificially generated waves of definite period, acting on a float so shaped as to oscillate with a minimum of resistance, and with the same period; it was invariably overset by the transit of four or

shape the circumstance that the whole mathematical theory of unresisted rolling can be worked out in reference to any individual ship on the basis of experiments which may be performed with her in still water. It will be seen farther on that the same mode of procedure is, with even greater appropriateness, available for the treatment of the difficulties which belong to the subject of resistance.

five waves. And this is what would, in fact, certainly happen to ships under the conditions named, if it were not that their oscillations are, in fact, performed in a resisting medium, and that their range is thus restricted by a growing force which will, in most cases, neutralise the increment before the fatal result ensues. But this branch of the subject has been, for the present, thrown out of the question, and will be noticed presently. At present it is enough to point out how thoroughly this conclusion, at least in its general form, accords with common experience, which tells us that if we wish to create the greatest amount of oscillation in a body capable of it, we must repeat the impulses, oscillation by oscillation, and in exact harmony with the phases of the motion. It will be in the experience of many Naval Officers especially, that even the largest ships may be worked up to an oscillation of very considerable range by running the crew from side to side, if only the runs are exactly timed to the recurring motion.*

The increment of range which, but for resistance, co-periodic waves would impose on the ship, wave slope by wave slope, or oscillation by oscillation, is $\frac{\pi}{2}$ (or about $1\frac{1}{2}$) times the inclination of the wave at its steepest part, so that on a wave, the steepest part of which has 6° of inclination, each oscillation would carry the ship 9° farther than its predecessor.

While this form of co-periodic oscillation is in progress, the ship's maximum inclination must always occur when she is at the top and bottom of the wave, and she is just at the middle of her swing when the mid-height of the wave passes her.

The result which is thus produced by co-periodic waves, is the most complete form of what is termed "cumulative rolling."

But cumulative rolling will also be produced by waves which are not co-periodic, though the amount of accumulation will be less, in proportion as the dissidence of the period or dis-periodicity (as it may be called) is great, since only part of each impulse can co-operate with the existing motion, and part must be antagonistic to it.

If the dis-periodicity is not very great, the transit of the first wave-slope will produce a result not far short of that which the first co-periodic wave would have produced; but, wave by wave, the want of harmony becomes more and more pronounced, the portion of the impulse which co-operates with the ship's roll becomes smaller, that which is antagonistic becomes larger, accumulation ceases and diminution commences, and thus the rolling, after attaining a maximum, dies out by just the same steps as those by which it had grown up.

Here again the results of the solution are strictly in accordance with common sense, and indeed with common experience.

A not uninteresting illustration of the action which has just been traced, is frequently furnished by the behaviour of a pocket-watch if divested of its chain and hung by its pendent on a nail, which often serves roughly as a knife-edge, and allows it to swing freely, as a

* This process is often adopted as a means of scouring a ship's bilges, a certain amount of water having been admitted to them that it may be thus forced to rush from side to side.

pendulum of very short period. In this condition, its period is generally not very far from that of the balance which is oscillating within it, and the alternate extensions and compressions of the balance-spring impress on it a series of alternating impulses of small but appreciable magnitude, and it will frequently be seen that the watch, regarded as a pendulum, will acquire a considerable series of oscillations, which, owing to the want of exact co-periodicity of impulse, grow up to a maximum, die out again, and recommence in an exactly reproduced order.

It is instructive to observe that the greatest increase of range which the transit of any single wave can, under any circumstances whatever, produce on the ship during a given roll, is when the phases of her rolling have become so related to those of the wave that the intervals of antagonism between the wave slope and the ship's motion, happen where the wave slope is near its minimum, that is to say, at or near the hollow and crest of the wave, the ship being inclined in such a direction that the approaching wave slope becomes piled up (so to say) on her inclination, and intensifies the righting force throughout the roll, the steepest part of the wave co-operating with the motion, and supplying an effective relative angle even when the absolute angle is near zero ; and the relation which plainly best satisfies these conditions is that, whether the period of the ship be greater or less than that of the wave, the commencement and termination of the roll shall be about equidistant in point of time from the hollow and crest respectively. The whole effort of the individual wave is thus applied with its greatest possible advantage towards the augmentation of the roll, and does the least possible towards the alteration of the period.

There remains to be mentioned a third type of unresisted rolling, which, however, grows out of the solution only in its most general shape, by assigning to the ship an initial inclination and angular velocity which have a special relation to the ratio of the period and the steepness of the waves.

This is what is called constant rolling, and it consists of a state of things in which the operation of the successive waves obliges the ship to roll to an invariable range, her period being forced into agreement with that of the waves, though these are in fact dis-periodic.

This result, it will be seen, is in marked contrast to that type of cumulative rolling which has been traced out as deducible from the simpler form of solution when applied under these conditions, namely when a ship is engaged with dis-periodic waves. It is, however, one which may be even quantitatively arrived at without any technical mathematical reasoning, and it appears more instructive to trace it out thus than to refer to it merely as a consequence of the solution.

If we consider what is happening when a ship is oscillating at her natural period in still water, we must perceive that the period of the roll is determined by the circumstance that the righting force is throughout not merely in direct proportion to the inclination at the instant, but that the numerical term which expresses the proportion, is exactly of such magnitude as to bring out the result which does, in fact, arise, namely, such as will oblige the ship to complete the oscillation in that particular

time. But it is easy to see that if the proportion had been other than it is, whether greater or less, the speed of the ship's motion at each instant would have been increased or lessened accordingly, so that the oscillation would have been completed in a less or greater time; and a little reflection shows that the relation which subsists between the increase of force and the decrease of period, or *vice versâ*, is that the period will be inversely as the square root of the intensity of the force. It is as the square root of the intensity, not as the intensity simply, because, when the force is, for instance, increased, and the velocity thus increased also, the time during which the force acts is thereby proportionally lessened, so that, for instance, it requires a force of quadrupled intensity to produce in a given swing a doubled velocity, or a period twice as short.

Now a scale of force thus uniformly intensified throughout, or *vice versâ*, may by hypothesis be exactly supplied to the ship while oscillating in still water, if we suppose a wave of appropriate steepness and period to be (so to say) administered to her as she rolls, if the relation of its phases as it operates on her be duly related to the phases of her rolling. This relation must, in fact, be such that the wave-phase which makes the wave-force zero, namely, the transit of its hollow or crest, shall operate on the ship at the moment when she is upright and is moving with her maximum velocity, as happens with the force naturally delivered during the still-water oscillation; and further, that (again in accordance with that naturally delivered force) the maximum wave-slope or phase of maximum wave-force shall operate on her when she is at the extreme range of her oscillation: and so on, throughout. If these two conditions hold, it will be found that a due apportionment of uniformly increased or diminished force has been secured, corresponding with the alteration of the period.

If, for instance, we desire to assign the wave-condition under which the ship will perform an oscillation of given range, in half her natural period, when, as was just now explained, the actuating force must be throughout quadrupled, we may see that the necessary conditions will be fulfilled, if the wave we assume has in the first place half the period of the ship, and, in the second place, a maximum inclination treble the ship's maximum inclination; for this trebled inclination, combined with the ship's own inclination, supplies, in the whole, the quadrupled force. It will be readily seen that the general proposition which this instance has illustrated, must include the condition, that when the ship's period is thus to be shortened, the advancing wave slope must face in opposition to the ship's roll, so as to intensify the righting force. When it is to be lengthened the wave slope must face in accordance with the roll so as to moderate the righting force.*

* It is readily seen in the light of this reasoning, that the constant relation which must subsist between the wave-slope, the ship's inclination, and the period-ratio, is (retaining the previously used notation) $(\theta + \theta') = \frac{T^2}{{}_{\prime}T^2}\theta$, or $\theta' = \left(1 - \frac{T^2}{{}_{\prime}T^2}\right)\theta$.

This of course includes the relation between the maximum wave-slope and the range of the ship's roll, which would be written $\Theta' = \left(1 - \frac{T^2}{{}_{\prime}T^2}\right)\Theta$.

This arrangement thus worked out would keep the ship rolling to a constant inclination, and with a constant but modified period, for an indefinite time. This then is what has been called "constant rolling."

It is instructive to contrast the conditions under which the passing wave slope simply alters the period of the ship's roll, without either increasing or diminishing the range of the roll, with those under which it leaves the period of the roll unaltered, but produces the greatest augmentation in its range which, as a single wave, it is capable of producing. The characteristic feature of the contrast is that at the mid-height of the wave when the wave slope is steepest, in the former case the ship's angular motion is zero, and the full range is attained—in the latter the ship's angular motion is greatest and she is in the middle of the roll. Thus the whole effect of the wave in the former case is devoted to the alteration of the period; in the latter to the augmentation of the range.

It is now time to turn to the essential but (theoretically speaking) somewhat obscure subject of Resistance; that force or set of forces, namely, which is called into existence in the surrounding fluid by the ship's motion, always acting in opposition to her motion, and tending to bring her to a state of rest.

It is not proposed here to deal with the subject in its theoretical and obscure aspect, but rather to trace the action as measured by experimentally ascertainable results, and to explain how these may be used to correct, or rather to complete and reduce into a practical form the abstract propositions in which the laws of unresisted rolling have been expressed.

Here also the behaviour of a ship when set oscillating in still water throws much light on the operation of the force we are investigating.

If, when by running men from side to side, or by other means, we have set the ship rolling to a considerable range, we cease the impulse and leave her to carry on the oscillation without interference, we shall see that, roll by roll, the range of oscillation becomes extinguished, and after a time the ship will come absolutely to rest. This extinction is obviously both the consequence, and the natural exponent, of the resistance experienced by the individual ship.

Supposing that by exact observations both of time and range, or what is better, by automatic means, we have obtained a record of the *rate* of extinction, we have thus in effect secured a measure of resistance in a shape which directly serves our purpose.

For while in the former part of the investigation we learned how much motion the transit of a given wave will communicate to the ship during the performance of a given roll, we learn in the ascertained rate of extinction, how much motion the resistance acting during the performance of the roll, will abstract from her. It is true that the solution thus obtained must be regarded as only an approximate one, but its *rationale* is simple and intelligible, and plainly takes us very far in the right direction, and on the other hand, it is found that practically the results which follow from it are very near the truth. It is true also,

that we cannot readily initiate artificial rolling to as great an inclination as to include the deepest rolls which possible waves will impose on the ship; but within the limits of easy experiment we can attain sufficient range to determine with considerable exactness, the law which governs the rate of extinction in terms of the range of the roll, and are thus enabled to calculate it pretty exactly for much deeper rolls. In fact, if after having performed the experiment and recorded its results, we mark off, on a base line, successive equal intervals, representing the count or numeration of the rolls, and duly plant on the base thus marked, a series of ordinates representing, to scale, their successive ranges, the ends of the ordinates will constitute a curve, which is a portion of what may be termed the "curve of extinction," and which may be extended by calculation as proposed.*

Speaking broadly, we may say that just as the theory of unresisted rolling has informed us what is the roll-originating power exerted by the waves, roll by roll, so this curve tells us what is the roll-extinguishing power exerted by the resistance, roll by roll; and it is plain that accumulation must cease when the rolling has become so deep that the two forces, roll by roll, are equal. And clearly this state of things indicates that under the operation of resistance, a form of constant rolling tends to become established, resembling, but differing of course in some characteristic peculiarities, from that already described.

The simplest case in which the application of this principle can be traced is that of rolling in co-periodic waves.

* It appears to me, both by experiment and by a rational appreciation of the data, that the rate of extinction as governed by the range, is expressible by the sum of two terms, of which one is simply as the range, the other as the square of the range, so that, if in mathematical language we put Θ as the range of the roll, and n as the number or count of the roll (*e.g.*, first, second, third, &c.), the rate of extinction or *loss of range per roll* will be $-\frac{\Delta\Theta}{\Delta n}$, and we have $-\frac{\Delta\Theta}{\Delta n} = (a\Theta + b\Theta^2)$, and the expression, if regarded as the differential equation of the curve of extinction, is readily integrated; and on a careful analysis of the numerous specimens of these curves which I have treated, it has proved in every case that such values of (a) and (b) might be introduced into the integral of the equation, that the calculated curve will fit the experimentally determined curve with remarkable exactness. Hence it is presumable that it would be found to accord pretty nearly with what would have been the result of experiment, if this could have been extended so as to include rolls of as great range as are ever encountered.

It is also probable that the terms which thus accurately express the resistance in the case of still-water rolling, will bring out an approximately correct result when applied to rolling in a sea-way, for it is presumable that the resistance the ship will experience in performing a roll of given range will, in the aggregate, be approximately the same, whether it is performed in still water or in a sea-way.

Only when the conditions are such that the ship is forced to perform the roll in a lengthened or shortened period, a correction must be made in accordance with the effect which the difference in velocity will have had on the resistance. But the correction may be readily made in virtue of the condition which rationalises the separate existence of the two terms of the equation involving Θ and Θ^2, the condition, namely, that the resistance is made up of two elements which are respectively proportioned to the velocity and to the square of the velocity with which the roll is performed.

Here, as we have seen, the transit of each successive wave slope would, but for resistance, be capable of adding, roll by roll, an increment of range $\frac{\pi}{2}$ (say $1\frac{1}{2}$) times, the steepest part of the wave, whatever be the range already attained; and this may be termed the potential increment. The actual increment which takes place in each roll will, therefore, fall short of this, by a quantity which corresponds with the extinguishing effect of the resistance during the roll, and will become zero therefore, when the range is so great that the rate of extinction equals the potential increment appropriate to the particular wave series.

Now, on reference to the complete curve of extinction, it is easy to see what part of the curve exhibits, as due to a single roll, a decrement of ordinate equal to the potential increment, and the ordinate at the middle point of this portion of the curve indicates the maximum range of roll which the particular wave series can impose on the particular ship.

When this state of things has been arrived at, so that the ship will, wave by wave, perform an oscillation of definite magnitude, in which on the whole, the impulsive force of each wave slope is balanced by the resistance experienced during the corresponding roll, the state of things is somewhat analogous to that of a clock pendulum which is kept going by the "maintaining power." In both cases alike the aggregate "work" communicated by the impulse, equals that abstracted by resistance, only that in the case of the clock the impulse is momentary, and is administered solely at the middle point of the swing, while with the ship engaged in this particular type of rolling, the phases of the wave and of the roll are so related, that the impulse is delivered continuously, and *pari passu* with the resistance, indeed throughout in tolerably exact proportion to it, for, as has already been explained in relation to unresisted co-periodic rolling, the instants of maximum inclination of the ship, when her angular velocity is zero, are at the top and bottom of the wave when the slope is zero, and the instant of her maximum velocity is almost precisely when the mid-height of the wave passes her, and the wave-force is at its maximum; and as the resistance increases and decreases with the velocity, a general equilibrium is thus approximately maintained.

The analogy between the maintaining power which sustains the swing of the clock pendulum, and the wave impulse which maintains the ship's oscillation, supplies a point of view from which we may see our way to what is virtually the conclusion which has already been reached, but in a somewhat different, and in effect, a more comprehensive form; as an answer, namely, to the question, what must be the steepness of a wave series of given period to keep the ship rolling with a given range, instead of to the question, what will be the range of oscillation imposed on the ship by a wave series of given period and given steepness.

If we trace out the answer thus in relation first to a co-periodic series, we shall see our way to the solution in a more general form.

If we assume the ship to be set rolling up to a given range in still

water, then if the medium in which she rolls were incapable of offering resistance, the rolling would continue for ever without any abatement, just as would happen with a frictionless pendulum oscillating *in vacuo*. If we now suppose the resistance of the water to begin to operate, we may propose to ourselves the enquiry, what system of surface disturbance must we at the same time impose on the water, in order to neutralise the extinguishing power of the resistance, and maintain the rolling with unchanged period and with unabated range.

Clearly the disturbance must be of the nature of a co-periodic wave series passing under the ship, with its inclination so apportioned to the ship's angular velocity as to be assisting the ship's motion, just as the resistance obstructing it.

Were it possible to create a wave series, the steepness of which should follow an arbitrary order in terms of time, we might make this order such as precisely to neutralise the resistance at each instant; but in fact we are not at liberty to assign this order precisely, since when the steepness of the wave series has been defined at any one particular point, the order of its steepness at other points is defined by inherent dynamical laws; yet, as has been pointed out, these inherent laws do in fact so define it, as to correspond very nearly with the order in which the resistance is delivered, and if we assume a wave series of such mean steepness, that its impulsive effect will be in the aggregate equal to the aggregate extinguishing effect of the resistance, the range of the oscillation will be conserved; only the intermediate variations of the ship's inclination as she rolls, will experience some almost infinitesimal modifications of alternate accelerations and retardations, during the progress of each roll.

Now the curve of extinction tells us how much of the assumed range would be lost by resistance in the single roll of the assigned mean range; on the other hand, the laws of unresisted oscillation tell us that the transit of a single co-periodic wave slope of given maximum inclination is capable of adding to the range of the ship's previous roll an increment of range, which is a little over $1\frac{1}{2}$ times that inclination, or (shaping the proposition suitably for our present purpose) to add a given increment of range per roll by the intervention of a co-periodic wave, we must make the maximum wave slope barely $\frac{2}{3}$rds of that increment, which is in effect identical with the conclusion already reached.

But having now gained the idea of a wave series as a maintaining power, we can apply it to the case of what has been called "dispeperiodic" rolling, and by help of this idea we may proceed to determine what is the wave series which will keep the ship rolling with a forced period, either longer or shorter than her natural period, and with a range unimpaired by resistance.

In the first place, we have already seen how, in the theory of unresisted rolling, the introduction of an auxiliary wave series, with its steepness and its phases definitely related to those of the ship's oscillation, will maintain in the ship the definite range of oscillation, but with the period altered in any assigned degree.

It is true that the alteration of period involves an altered scale of

velocity in the performance of a given range, and, therefore, an altered scale of resistance ; so that the data presented by the curve of extinction are not nakedly applicable ; but, if we know the law of resistance in terms of velocity, we can deduce from the curve of extinction the extinguishing power of the resistance operating during any given roll, if performed by the ship, in either a lengthened or a shortened period ; that is to say, if we know the obstructive " work " done by resistance during the roll of given range if performed in the ship's natural period, we can determine it when the same roll is performed in the altered period, and can also determine the corresponding new decrement of range.

Hence, proceeding by exactly the same method as before, we can define in terms of this newly determined decrement, the steepness of the auxiliary wave series which is required as a maintaining power to neutralise the effect of resistance operating under the altered period.

Thus, to maintain the rolling of given range in a dis-periodic wave series, the combined operation of two distinct auxiliary wave-series is required—one of which may be called the "period-governing" series, the other the "maintaining" series ; but for reasons which have been already explained, the relation between the wave phases and those of the ship's oscillation, are characteristically different for the two auxiliary wave series.

The instant of the maximum wave slope in the "period-governing" series, concurs with that of the ship's maximum inclination and the zero of her angular motion ; in the "maintaining" series, it concurs with the zero of her inclination and the maximum of her angular velocity.

The combination, or superposition as it is called, of these two auxiliary waves, creates the total wave by which the roll of given period and range will be maintained in the ship. Perhaps, however, those to whom the idea of a wave, consisting of several waves in superposition, is for the first time presented, may desire some explanation.

The figure or profile of a wave-series is represented with sufficient exactness by a continued repetition of what is called the " curve of sines," a curve the nature of which may be sufficiently described to those who are not conversant with it mathematically, as follows :—Imagine a clock pointer to travel once round the dial, while the wave passes from crest to crest, and let the length of the hand be half the height of the wave from hollow to crest, when drawn to the required scale ; draw a horizontal diameter across the dial, and draw a base line, spacing it off with intervals representing either the length, or the period, of the wave from crest to crest, then subdivide each of these intervals into twelve equal spaces, corresponding with the time intervals at which the pointer arrives at the successive hour-marks on the dial, and at each station thus fixed on the base, draw an ordinate, the length of which is the vertical distance of the end of the pointer, above or below the diameter ; the length of this ordinate represents the height or level of the wave surface at that instant.

The following well-known and interesting property of this kind of curve, illustrates what is called the superposition of waves :—

Draw any two such curves on the same base, making them alike only

in the length of base, and different to any extent in their vertical height, and in their respective starting points on the base. Then add, at each point on the base, the ordinate of the one curve to the ordinate of the other, observing only that when the one ordinate is on the opposite side of the base from the other, addition means subtraction. The combination constitutes a third curve, not only like in character to the other two, but actually a true curve of sines, differing from its constituents only in the diameter of the imaginary circle from which it is constructed, and in the position of its starting point on the base.

The geometrical property thus traced out, explains at once the geometrical result of the combination of the two auxiliary wave curves, and the conservation of the dynamical operations which the waves were calculated to supply separately; for the steepness or slope of the combined wave (just as happens with the ordinate representing its profile) is everywhere the sum of the slopes of the constituent waves, and it thus correctly performs, in the lump, their separate duties.

The compound wave series is, in fact, the wave series which will keep the ship rolling with the given range; and if for a sufficiently extensive series of imagined ranges and periods of rolling, we deduce the elements of the appropriate compound waves, and tabulate the results, it is as easy to read the table backwards as forwards, and infer from the elements of the wave series, what is the range to which it would make the given ship roll.

It is necessary to point out that this tabulated range, is that which the ship would reach only after several consecutive waves had passed her. For when first acted on she would commence moving as if she had no power of resistance, and would thus more or less faintly conform to that type of unresisted rolling which belongs to dis-periodicity, and which involves the growth of the range to a maximum after several rolls, with subsequent diminutions in a recurring series; indeed if the ship possesses but slight power of resistance it is probable that the first, or even the second of the recurring maxima, will be slightly in excess of the final range as given in the table.

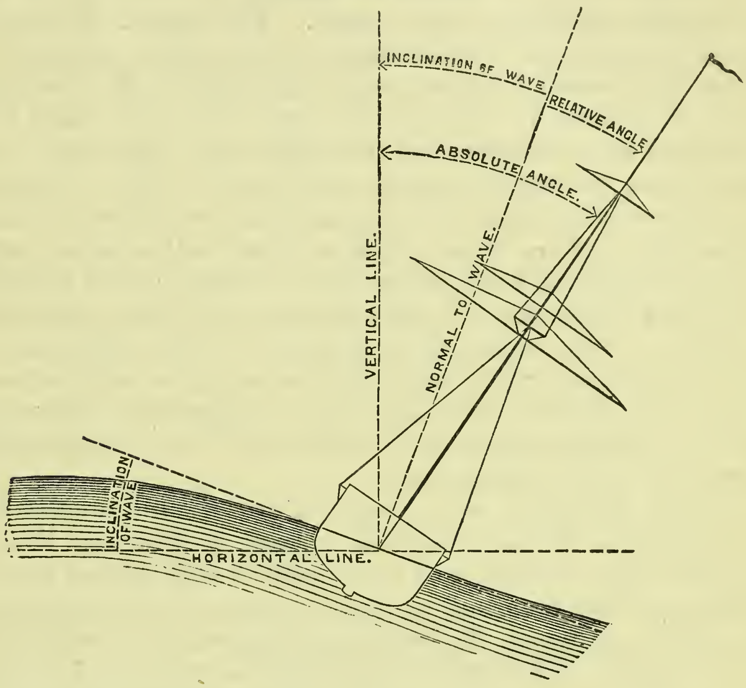
The excess cannot be large. Its actual amount can only be determined, so far as I know, by a process of "graphic integration," which it would occupy too much space to describe here. It may, however, be added that, speaking broadly, it remains true that in resisted as well as in unresisted rolling, the wave-series of given steepness which will impel a given ship to the greatest range of rolling, is that which has the same period as the ship herself.

Having now sketched the general principles that govern the rolling of ships, and traced their leading results, I will proceed to the consideration of the recording apparatus which it is the object of this lecture to explain. It is manifestly of great importance to have the power of verifying and of correcting the theoretical conclusions at which we have arrived. To do this we require the means of recording exactly the behaviour of any given ship under various conditions of the sea, and of recording at the same time what those conditions are.

This is done in the present apparatus, by keeping a continuous

record, first of the angle which at each instant of time the ship's mast makes with a truly vertical line; and, secondly, of the angle which at each instant of time the ship's mast makes with a line drawn normal, that is to say, at right angles to that portion of the wave-surface on which the ship is at the instant of time referred to. The first of these angles, namely the angle between the ship's mast and a truly vertical line, may be conveniently called the ship's *absolute angle*, and the second angle, or the angle between the ship's mast and the normal, may be called the ship's *relative angle*, as being taken relatively to the wave-surface (see Fig. 4). The *absolute angle* is the angle

FIG. 4.—EXPLANATION OF THE TERMS "ABSOLUTE ANGLE" AND "RELATIVE ANGLE."



usually referred to in all ordinary records of ships rolling; thus, when it is stated that a ship rolled 10 degrees to port, it means that her mast made an angle of 10 degrees on that side with a truly vertical line. It will be evident, however, from the principles set forth in considering the causes of the rolling of ships, that it is important not only to record the *absolute angles* of a ship's rolling, but also her angles *relatively* to the wave-surface, it being borne in mind that the righting tendency of the ship tends to place her mast at right angles to the wave-surface. It must also be remembered, that the apparent direction of gravity to a body floating on a wave, is at right angles to the wave-surface, as was indicated in the experiment of the short plumb-line on the float, either in the suspended cup or in the wave-water (see pp. 859, 860, and Figs. 1, 2, and 3).

A vessel may to all intents and purposes be considered to roll about her centre of gravity, and thus the centre of gravity while partaking

of the vertical and translatory motions imparted to the vessel by the waves, will be free from the rotatory motion experienced by the other parts of the vessel, and a pendulum hung freely at the centre of gravity of a ship will not be disturbed by the rolling of the ship, and will thus be under conditions similar to those of the plumb-line in the small experimental floats before referred to.

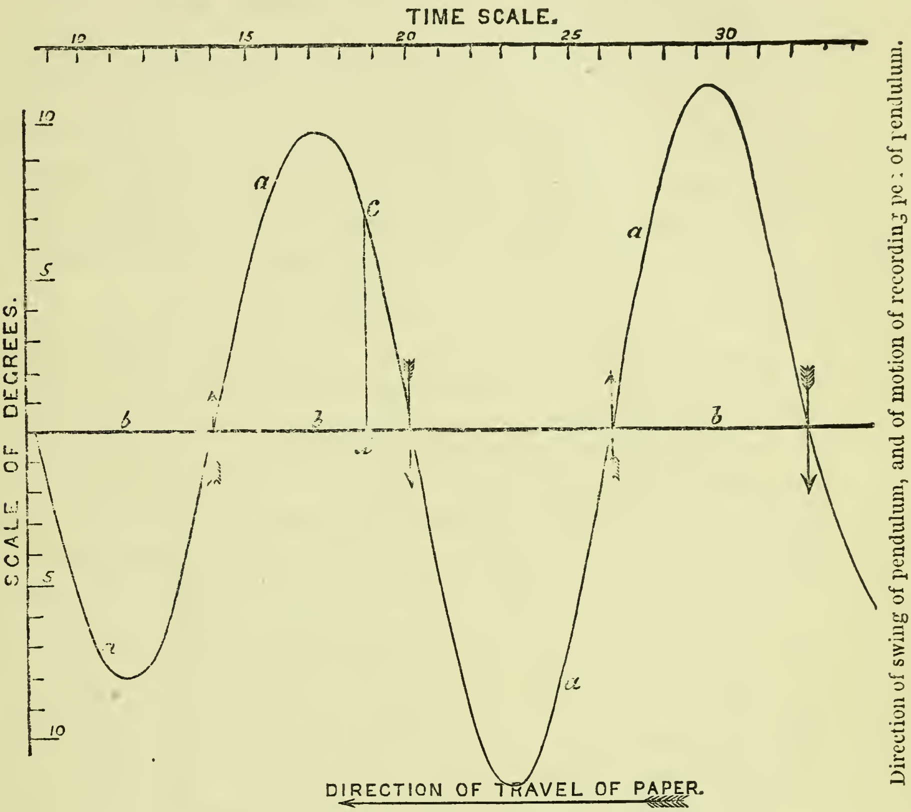
But for the reasons I have before pointed out, even a pendulum hung at the centre of gravity of the vessel in a seaway, will not, as on shore or in still water, hang constantly in a vertical line, but it will point in a direction at right angles to the wave-surface, so that its record is fallacious if taken to indicate the *absolute angle* of a ship's rolling. Still more misleading is the record of a clinometer placed at any part of a ship other than the centre of gravity, for then it will be subject to the rotatory motions of the vessel. The extent of the error thus introduced is exhibited by the larger inclinations assumed by lamps hung, even with much friction, under the upper deck of a lofty ship, or the extent to which in walking the upper deck of a vessel rolling, one must, in order to counteract its sideways sway, lean over to an angle far greater than the angle actually rolled by the ship. For instance, a pendulum-clinometer hung at the upper deck-level of an old line-of-battle ship would often swing to an angle at least half as much again as the true angle of the vessel's roll on the wave. Moreover, as the clinometers placed on board ships are of some length and freely suspended, they, when subject to the rotating movements of the vessel, set up a considerable swing of their own, and thus the record is still further vitiated. There can be no doubt that many most exaggerated statements as to the angles to which vessels have rolled, are due to the angles having been measured by the clinometer.

But though fallacious as a record of the *absolule angles* rolled by a ship, a pendulum gives a valuable record if hung at the centre of gravity of the ship. Here, as I have said, it will be free from adventitious influences, and will tend to point constantly in a direction at right angles to that portion of the surface of the wave on which the ship is for the movement. If, then, we can keep a continuous record of the positions which at each instant of time the pendulum assumes—assumes, that is to say, in relation to the mast of the ship, we shall have a record of the *relative angle*, that is to say the angle which the ship herself makes at each instant of time with the wave-surface. I will here point out that, as I have said, the tendency of the fluid pressures is to set the ship at right angles to the wave-surface, and as this tendency is measured in terms of the angle the ship makes with that wave-surface, it follows that the record given by the pendulum, forming, as I have said, a continuous record of the *relative angle* the ship makes with the wave-surface, supplies also a continuous record of the forces of the water acting on the vessel to cause it to rotate in the one direction or the other.

The way in which the successive positions of the pendulum are continuously recorded, will be familiar to most of my hearers, being similar to the self-recording operations of indicator diagrams, tide gauges, &c. As the pendulum swings in the ship, it moves a hori-

zontal rod, which works a pen to and fro over a sheet of paper, and this is made to travel at right angles to the swing of the pendulum, at an uniform speed beneath the pen, by passing over a cylinder which is made to revolve by clockwork. A wavy curve is thus traced on the paper (see Fig. 5.) To interpret the diagram, a base line or zero is

FIG. 5.—DIAGRAM LINE TRACED ON MOVING PAPER BY PEN ACTUATED BY PENDULUM.



a. Curvilinear line traced on moving paper by recording pen.
b. Zero line, or straight line, that would have been drawn by the pen had the ship's mast remained at right angles to the wave slope, and thus not deviated from the line of the pendulum or the apparent direction of gravity.
In this diagram, the ordinates of the curve, as *c d*, indicate, by the scale of degrees, the "relative angle," or the angle made by the ship's mast, with the normal to the wave surface at the instant of time represented in the diagram by the distance along the line *b* of the point *d*.

drawn along the paper intersecting the wavy line and occupying the position which the pen would have occupied had the ship remained at rest, with the pendulum hanging parallel to her mast. Lengths measured along this base by the time scale denote time, and if at any point in the base an ordinate be drawn to the wavy line, the length of the ordinate, measured by the scale of degrees, denotes what was the angle between the pendulum and the mast at the corresponding instant of time.

The pendulum in this apparatus is made very heavy, and has a very short period. In appearance it is very unlike what is usually understood by a pendulum. Instead of a long bar with a big weight

at the end of it, it is a horizontal heavy cylinder suspended by its upper edge (see Fig. 3, plate XLVIII*). Thus, while very heavy and powerful, the weight is very near the point of suspension, and consequently the time of each swing is very short. A pendulum like this, of short period, while it instantaneously obeys the forces impelling it to set itself at right angles to the wave surface, is much less liable than a longer pendulum to be influenced by any adventitious causes, and is less likely to set up, so to speak, a swing of its own. The pendulum is delicately hung on knife edges in a special manner, which I shall have occasion hereafter to refer to.

I have now, I think, explained how a pendulum, though misleading as a record of the *absolute angle* of rolling of a ship, may be usefully employed to furnish a continuous record of the relative angle, which, let me remind you, measures at each instant the righting force acting on the ship. Before leaving this branch of the subject, I should mention that this method of recording the relative angle had been successfully adopted by M. Bertin, an able French naval architect of Cherbourg, before it independently occurred to me.

I will now proceed to consider the methods for observing the absolute angle of a vessel's rolling, that is to say, the angle which her mast makes with the vertical. By far the readiest point of departure for this purpose, when it is available, is an observation of the horizon. To the uninitiated I may explain that an observer standing up in a ship sufficiently high to observe the horizon clear of the waves, sees the horizon apparently rise and fall up and down the rigging as the vessel rolls, and by using the spaces between the ratlines of the rigging as a scale, a very correct appreciation of the angles to which the ship rolls, may be obtained. To employ the same principle more exactly, a graduated staff or *batten* is fixed upright against the bulwark of the ship, with degrees of inclination marked on it. The observer, with his eye at a proper height and distance from the staff, notes the angles to which the ship's side is depressed and elevated in reference to the horizon, or, in other words, the *absolute angles* of rolling of the ship. But this observer cannot do more than note the extreme angle reached by the ship in each roll, or at most, with the aid of an assistant with a watch, he can note the extreme angle, and the time at which each roll is made.

It is, however, desirable to obtain a continuous record of the angle assumed by the ship at each instant of time, a record, in fact, analogous to that which I have already described as given by the pendulum. If we had in the ship a bar endowed with the property of remaining truly vertical, or indeed in any fixed position in a vertical plane, it is clear that this bar might, like the pendulum, be made to actuate a pen which pen should trace a line recording the angles which at each instant of time the ship makes with the fixed bar, or in other words with a truly vertical line. It is to supply this fixed bar that the special portion of the apparatus I have to describe has been designed.

In some of the experiments I have lately conducted on the rolling of ships at sea, the function of this fixed bar was supplied by a rod or

* The Institution is indebted to the Institution of Naval Architects for Plates XLVII and XLVIII.—Ed.

ed by Chas. Ingram.

To illustrate Mr. Froude's Paper on an Instrument for automatically recording the rolling of Ships.

Fig. 1. General arrangement of Apparatus.

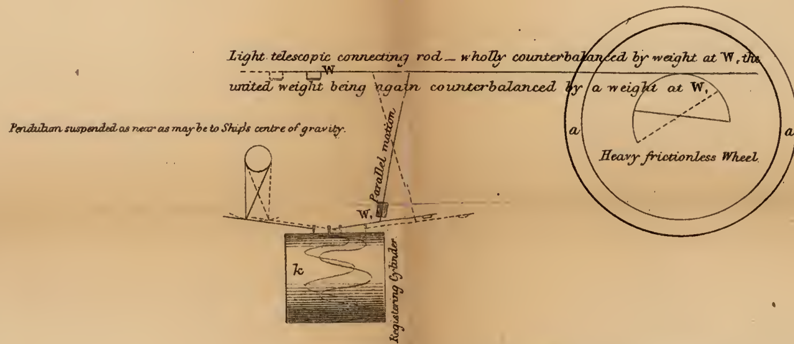


Fig. 2. Mode of mounting frictionless Wheel. Scale 1 inch = 1 foot.

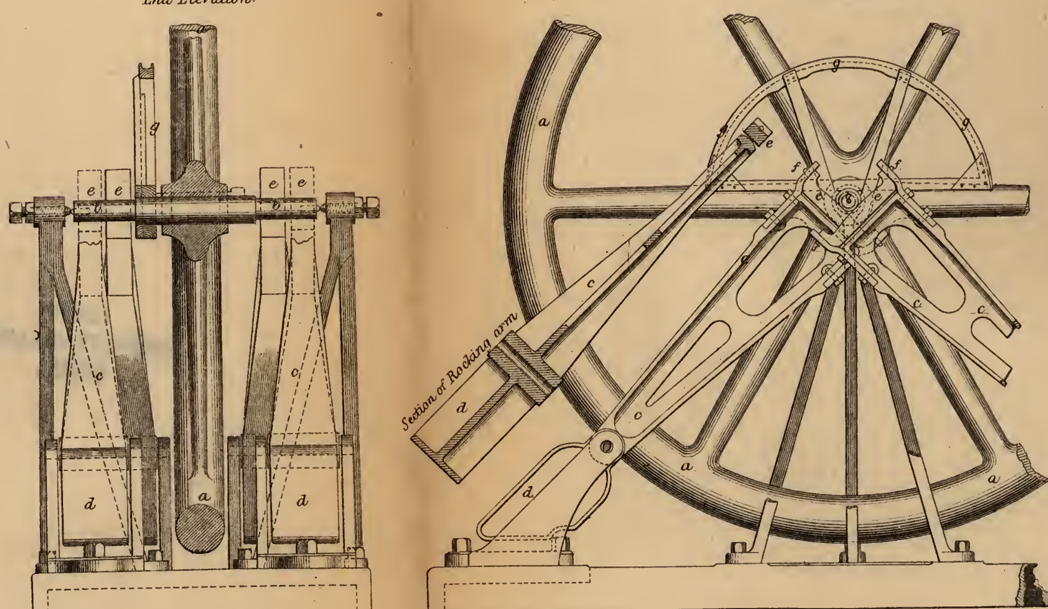
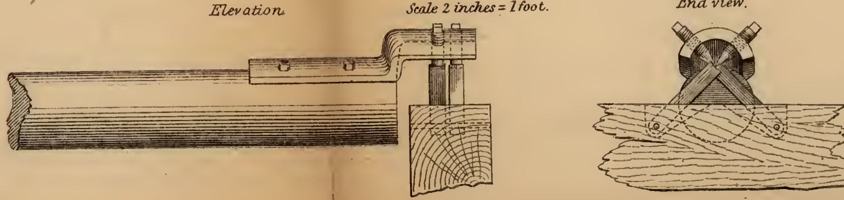


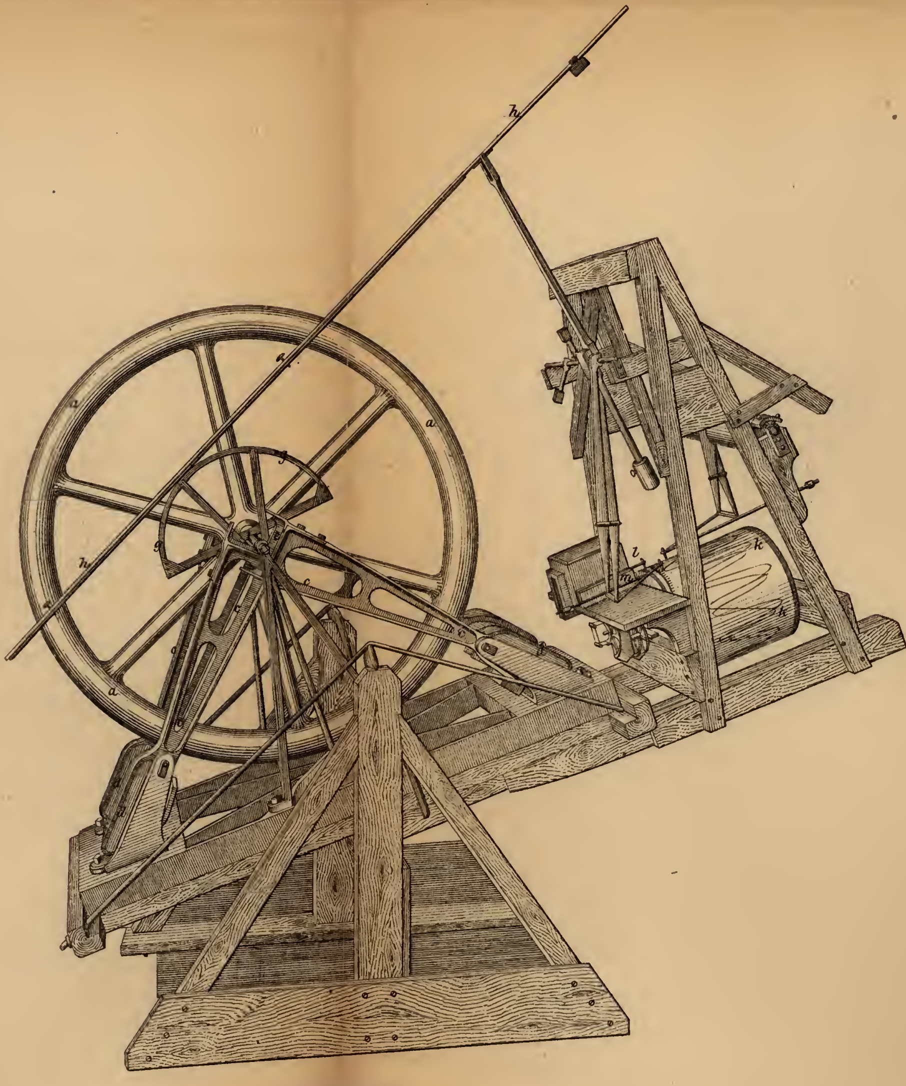
Fig. 3. Knife edge arrangement for suspending Pendulum.



Engraved by Chas. Ingram.

To illustrate Mr. Froude's Paper on an Instrument for automatically recording the rolling of Ships.

From a photograph of the apparatus as mounted on a rocking platform representing the deck of a Ship rolling in a seaway, and for the instant greatly inclined.



Engraved by Chas. Ingram.

pointer, which an observer on the upper deck of the vessel kept level by pointing it continually at the horizon. The motion relatively to the ship, of this really motionless pointer, was conveyed to its recording pen by strings led down through the deck. It is evident, however, that a method of this sort, depending on the skill of an observer, and which can be only employed in daylight, should, if possible, be replaced by some self-acting piece of mechanism.

Admiral Paris has suggested and applied the gyroscope for this purpose, but the difficulties of maintaining continuous rotation and of rendering the suspension of the gyroscope sufficiently free from friction, have proved too great for its useful adoption.

I have accomplished the result by paying due attention to the far simpler dynamical principle, that a mass of matter which is at rest will remain at rest, except so far as it is put in motion by external force, and thus if, while we push it about, the force by which we push it is such as will not communicate rotation, no rotation will ensue. Now, any mass of matter suspended by its centre of gravity is, theoretically, in this condition, and a balanced fly-wheel is in this condition if held only by the centre points on which it balances, assuming this suspension to be frictionless. If the wheel thus mounted were placed on the deck of a ship, the ship might be swayed about by the waves and might oscillate incessantly beneath the wheel without imparting to it any rotary motion. It would remain thus at rest, simply because there was no cause for its assuming rotation. But to utilise this method in practice, it is necessary to adopt some method of suspension most carefully freed from friction.

The use of a knife-edge suspension, such as that of a delicate scale-beam, would be a ready way of securing the result; but, unfortunately, a knife edge, to work with exactness, requires a level, or nearly level, plate to rest on, which could not exist in a rolling ship; while a notch deep enough to prevent the knife edge sliding sideways, under deep inclinations of the ship, would be fatal to its proper action. The well-known expedient of a cylindrical axle running on friction rollers, of course suggests itself as an alternative, and it is seen this may be simplified, when it is recollected that the angles through which the ship rolls are limited, and an absolute rotation of 60 degrees on either side of the position of rest is more than sufficient for all the duty that could legitimately have to be thrown on the axle, by the oscillation of the ship. Hence but a very small portion of the circumference of the friction rollers can be called into play, and it is thus sufficient to provide only a small segment of the circumference of the roller, instead of a complete wheel, and the radius may be thus greatly enlarged without introducing cumbrous dimensions in the apparatus as a whole. In fact, this arrangement has been successfully employed as a frictionless method of suspending clock pendulums.

Assuming that a heavy wheel may thus be provided with a practically frictionless suspension, there remains, however, the necessity of obliging the relative motion of the ship and the wheel, to produce a continuous record on a travelling sheet of paper, and it is obvious that this process can hardly be accomplished without the introduction of

some adventitious friction, involved in the process of marking the line, or in the motion of the parts which carry the marker. This adventitious friction, however, is of course independent of the weight of the wheel; and, by making this weight sufficiently large, the friction, per pound of weight of wheel, may be reduced so far as to be immaterial.

Thus far the wheel has been spoken of as absolutely balanced on the axis of support; but it is plain that under these circumstances the slightest motion, if once imparted to it by any accidental cause, such as a touch from the hand or even the clothes of the attendant, would continue without abatement, and that the wheel would ultimately overrun the range of the friction rollers, nor would it be possible for a bystander in the moving ship so to touch the wheel as to set it at rest in its proper position. This difficulty may be surmounted by giving the wheel a slight preponderance on one side, making its centre of gravity slightly eccentric—thus making it, in fact, a pendulum with a very long period of oscillation. It is true that it becomes thus subject to the disturbing causes which necessarily operate on a pendulum suspended in an oscillating ship. But if the preponderance is very small, and, consequently, the period of the pendulum is extremely long, the time during which a disturbing cause operates in one direction is relatively so short that the amount of disturbance actually created during its operation, may be rendered inappreciable, and will be obliterated during the counter oscillation. In fact, bearing in mind that, on the average, the sea is level and the ship is upright, the wheel with its slight preponderance, if set in motion, will simply oscillate very slowly, and will gradually come to rest in its proper mean position, the motion becoming gradually extinguished by the resistance of the air and other retarding causes. Having thus generally characterised the conditions which must be adhered to to give effect to the suggested method, I will point out how they have been carried into effect in the apparatus shown in Plates XLVII and XLVIII.

The wheel (*a*) weighs 200 pounds, and is 3 feet in diameter; it rests on an axle of steel, coated with hard steel collars (*b*), 1 inch in diameter. The centre of gravity is about ·006 of an inch out of the centre of the axle, and the time of a single swing from right to left is about 34 seconds. Each friction roller arm (*c*) has a radius of 18 inches, and consists of a stout casting, with a counterbalance (*d*) below its pivots; the segment-facings (*e*) are of hard steel, $1\frac{1}{4}$ inches broad. It will be seen that if these were rigidly fixed to the radii, the axle would almost inevitably take its bearing on one or other edge of each segment. To prevent this they are mounted on pivots (*f*), so as to square themselves into perfect contact with the axis. The delicacy of the suspension is attested in this particular instrument by the smallness of the rate of extinction of its own oscillation when put in motion, and by the fact that when at rest, a breath on the circumference will move it perceptibly.

The axis carries a wooden semi-circle (*g*) having a circumference $\frac{1}{8}$ inch to a degree, and by a connecting-rod (*h*), which takes the motion of the circumference lineally, the angles are transferred to and become marked on the travelling sheet of paper (*k*), tracing a continuous curve (similar to that already described as

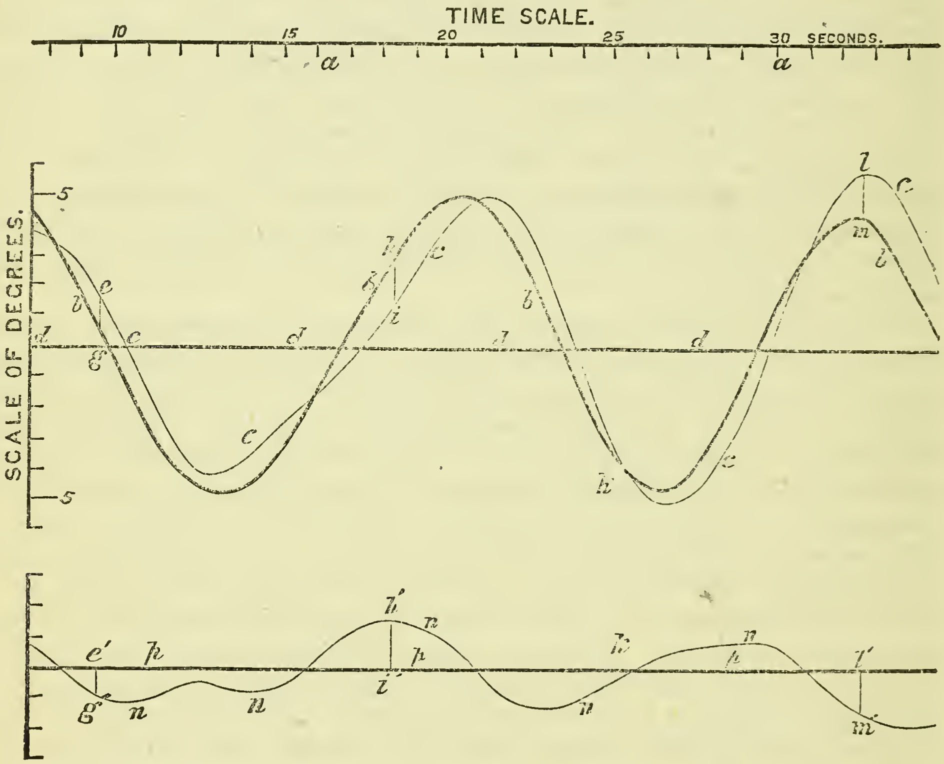
traced by the pendulum) the ordinates of which are the absolute inclinations of the ship at each instant, and the abscissæ the intervals of time. The motion of the paper is nearly isochronous. The paper, however, has a time scale marked on it by a piece of clockwork (l), as it travels. Each line is traced, not by a pencil—for this requires pressure to secure its marking—but by a pen consisting of a light vulcanite cylinder 0·1 of an inch in internal diameter, which delivers the ink through a conical metal point, having an aperture 0·005 of an inch; the pen and the arm that carries it (m) are counterbalanced, so that its point barely touches the paper, while the ink is delivered by its capillary adhesion to the paper. The friction is thus practically inappreciable. Should it happen, as it occasionally does, that the wheel is put into motion by some accidental external impulse, the oscillation thus instituted is performed with the long periodic motion which the wheel independently possesses, and thus it scarcely even disfigures the curve which shows the ship's oscillation. The result simply is that the curve is thus referred to a base-line of small definite curvature, instead of to one absolutely straight. The angles indicated by the pendulum, are similarly traced on the same paper and to the same scale.

Before leaving the subject of the details of the instrument, I should mention that I propose to make trial of a somewhat different arrangement for the frictionless support of the wheel. Although the arrangement as it stands at present, has answered very well, it requires great attention, as a very small speck of dust getting between the segments and the axis of the wheel, is sufficient to impede the free motion of the parts, and to set the wheel oscillating. I said before that a knife edge suspension for the wheel would not answer, as a knife edge to work properly must rest on a level, or nearly level plate, which could not, of course, be obtained in a ship, where, if the plate was tilted, the knife edge would slide off. However, after this instrument was made, it occurred to me that the difficulty of employing knife edges might be got over by placing, at each end of the axis, two knife edges at right angles to one another, with their edges in the same straight line, in prolongation of the centre line of the axis of the wheel, one knife edge being nearer to the wheel than the other, but both of them being rigidly connected with the wheel. These knife edges would rest on flat plates, which would be placed at right angles to one another. Thus the tendency of each knife edge to slide down over the inclined surface of the plate it was resting on would be prevented by the other knife edge pressing against its plate. To prevent any rubbing of the knife edges on the plates, and to allow for any errors of workmanship in fixing the knife edges in their exact position, the plates on which the knife edges rest, will be made so as to rock on short radius arms, in a similar manner to the segments on which the wheel axis now rests. Not only will this arrangement of knife edges be simpler and more compact than the present arrangement, but the small bearing surfaces of the knife edges will be able to crush and obliterate particles of dust, which would have done mischief between the circular axis and the segments. This arrangement of knife edges is adopted for the bearings of the

heavy short period pendulum already described, and is shown on Fig. 3, Plate XLVIII.

To return to the objects of the apparatus now before us, and having described the manner in which we obtain two curved lines drawn on paper which supply us with the information we require as to the *absolute angle* and the *relative angle* of the vessel's mast at each instant of time (see Fig. 6), I wish to point out that from these two records we

FIG. 6.—EXAMPLE OF DIAGRAM MADE BY INSTRUMENT, SHOWING RESULT OF ANALYSIS OF IT.



a. Time scale marked by clock on the paper as it travels.
b. Curvilinear line drawn by wheel, and indicating by its ordinates, to scale, the "absolute angle" of the ship at the instants of time indicated by the time scale.
c. Curvilinear line, drawn in like manner by pendulum, and indicating "relative angle" of ship at each instant of time.
d. Zero line to which the ordinates are referred.
n. Curvilinear line referred to a zero line, *p*, deduced from the curvilinear lines, *b* and *c*, by taking the differences, as *e g*, *h i*, *k*, *l m*, between the ordinates of these two curves, *b* and *c*, for the ordinates *e′ g′*, *h′ i′*, *k′*, *l′ m′*, of the line *n*. Thus the curvilinear line *n* represents by its ordinates the difference at each instant of time between the absolute angle and the relative angle; and this difference (see Fig. 4, page 875), is the wave slope.

NOTE.—In the actual diagrams as taken by the instrument, the lines *b* and *c* are not placed, as here shown, in their correct juxtaposition, since it is necessary in order to allow the pens to pass one another that they should work in different positions on the paper, hence before analysing the diagrams, one of the curves has to be "plotted" again in its correct position. Also, the curvilinear line drawn by the wheel has to be corrected for any curvature in its zero line due to long oscillations of the wheel. Both these corrections have been made in the diagram here shown, which is taken from an actual diagram produced by the apparatus.

can at once obtain a measure of the wave slope on which the ship is at each instant of time.

For this wave slope will clearly be the difference between the absolute angle and the relative angle (see Fig. 4, page 18), and so the angle

of the wave slope at each instant of time, is represented on the diagram by the distance between the two curved lines. Now by knowing the wave slope at each instant of time, we can graphically describe the form of the wave by plotting on paper successively the different inclinations of wave surface indicated by the diagram. But although we can thus draw the form of the wave, we do not know its actual dimensions. We have a correct drawing, but we do not know the scale on which it is drawn. We can determine this, however, in the following way: if the interval of time between the passage of two successive waves is known, the received theory of waves tells us what is the distance between the crests of those waves. Now a reference to the diagram tells us the interval of time between the passage of two of the wave crests we have drawn, and thus we can find the distance between the wave crests, and so we get the scale of the drawing of the wave.

Here then we have by the pendulum and wheel diagrams, a means of recording the waves which act on a vessel at sea. We have by the pendulum diagram, a record of the forces tending to make the vessel roll, and we have by the stationary wheel diagram a record of the extent to which the ship actually does roll. Thus a great help is given to our power of treating theoretically the rolling of ships, for we have the means of verifying our theory by practice, seeing in what way they differ, and determining the cause of that difference.

For instance, we have determined for a given ship, by rolling her in still water, her scale of resistance to rolling, and from this we are able to predict what will be her behaviour in any given waves. We try the same ship at sea, and from the diagrams we obtain a record of the waves she experienced. We then apply our information as to the still-water resistance, and calculate what, according to theory, should be the ship's behaviour, namely to what angle she should roll at each point of the waves in question. But we also have an exact record of what she actually did do in those very waves, and we thus have a crucial test of the accuracy of our calculations.

I may mention that in some experiments conducted for the Admiralty, this test has actually been applied in the case of two ships of over 1,000 tons, one of them having large bilge keels, and it appeared that the actual oscillations in the seaway went precisely through the phases which the theory prescribed; but as regards the amount of roll, the angles actually reached were throughout slightly less than those theoretically deduced, and this indicated that either the resistance experienced by the ships while rolling in the seaway was greater than that indicated by the still-water trials, or that the effective wave slope was throughout somewhat less than that indicated by the diagrams.

Also by the accurate records given by this instrument, we can determine the merits of different forms of ships so far as their qualities affect their rolling, for we can measure their behaviour under strictly comparable conditions. It is impossible to get the sea exactly alike on different days, and thus great differences of opinion exist as to the relative merits of various ships. But with this apparatus we can tell what were the conditions under which a vessel exhibited exceptional behaviour and in what respect those conditions or that behaviour differed from

those experienced or exhibited by the same or other ships at any other time. We are able thus to judge of the value of the various devices tending to modify the rolling; the effect of alterations of stowage of the additional of bilge keels, and of the steadying effect of canvas can be exactly recorded and measured. The direction in which to search for further remedies may thus be indicated, and important improvements may be confidently anticipated.

The CHAIRMAN: I do not know whether any one will venture to discuss this paper, but if any gentleman wishes to ask any question, or to have any further explanation, I have no doubt Mr. Froude will be very glad to afford it.

Captain COLOMB, R.N.: A *sotto voce* remark fell from the Chairman, that he thought nobody would dare to make any comments upon the paper, and I feel his difficulty, the condition of things being this, that whereas an audience in this theatre listening to a paper is usually in the position of a number of critics upon the performance of the reader of the paper; our position to-night is that of a number of disciples sitting at the feet of a master. I should think that nobody in the Navy, and I might possibly go further and say, nobody in Europe, would attempt to *criticise* such a paper as we have heard to-night,—most elaborate, and yet so clear, that even I suspect the thickest of our heads (and I number mine amongst them), have been able to follow it to a very great extent. I do not suppose that it is possible to offer that sort of criticism which Mr. Froude, in common with other great minds, would wish for. But what one would like to do would be to try to convey to a mind such as his, some of the difficulties that ordinary minds such as ours feel in following him. My difficulty, and I only mean to advert to one, is that purely elementary one upon which the theory of the wave rests. I understand, so far as I have read the papers on the now received theory of the formation of waves, that any particle on the surface of an advancing wave slope describes a circle in a direction opposite to that in which the wave is travelling; that it reaches the top of the circle at the moment the crest of the wave reaches it, and that, consequently, it finds itself just where it started when the wave has completely passed, supposing that it started from the bottom of the wave slope, and that the slope passed it, and then that it found itself at the bottom of the next hollow. Now my difficulty is to understand that translation of the wave particle. Waves we know are of very great height, and the diameter of the circle described by a particle on the surface of a wave may reach, I suppose, 30 feet. Now it is a difficulty to my mind to get the theoretical fact to coincide with one's personal observation. I have not myself, except in breaking waves, observed that particuar translation. And there is one observation that I have made which increases the difficulty to my mind. When a perpendicular surface, such as the side of a breakwater, is offered to advancing waves, any small object lying within a foot or two of the perpendicular surface does not appear to an observer to alter its distance from it. Its motion appears to be distinctly vertical; as the wave rises, so the object rises; as it falls, so the object falls. But you cannot by that sort of observation detect a difference in the slope of the wave, nor is there in such a case any break or disturbance of the surface of the wave itself. It is of course quite different in a breaking wave, such as we see in a surf. There we have what is described a distinct motion of the particles which we can detect with our eye. We know that if you place a small object on a rolling surface, you observe that it has that motion of translation which I understand it is supposed that every particle of a wave has, even in deep water. We have that translation in a breaking wave very distinctly brought under our observation in every rolling sea. We are accustomed to note the commencement of the breaking of a wave, and after the wave has completely spent itself and broken, we can trace a long drift of foam where the breaking wave has passed over. That, Mr. Froude, is my difficulty. I hope you do not think I am a doubter. I am trying to be a learner, and no more, and I think if you can descend to our minds, I should just like to give one piece of confirmation to some points you have stated which are to those who have studied the question quite accepted, but I believe are not so accepted generally in the Navy; one is the isochronous vibration of ships. I made it my

business last time I was at sea, at any spare moment, whatever the state of the sea was, even in comparatively close harbours, to take that sort of rough observation which was possible, and I found in the ship I was in, no matter what the state of the sea was, in the heaviest sea and when the motion was hardly perceptible, the motion of the ship never seemed to be under 11 rolls, and never over 13.

Again, another point you adverted to was that cycle of rolling; that is how, in certain seas, you arrive at a maximum arc, and then that your roll became less and less down to a certain point, at which it began again to increase. I made observations upon that point, and I have tracings of the rolls, where I noticed that most distinctly; but I did not at that time know the cause, which has been explained to us to-night.

Dr. HIRST: Since the efficacy of the beautiful piece of mechanism which Mr. Froude has exhibited to us this evening, depends essentially upon the perpendicularity to the surface of the wave passing under the ship, of the direction indicated by the short pendulum of his apparatus, I should like to ask him to what extent this perpendicularity may be actually relied upon. The diagram on the right represents an extreme case, the circumstances of which might be roughly imitated by rigidly connecting the point of suspension of a short pendulum with the circumference of a large wheel, and on the concave side thereof. Now if the wheel rotated with sufficient velocity, centrifugal force would undoubtedly preponderate to such an extent as to maintain the perpendicularity of the string of the little pendulum to the immediately adjacent part of the circumference, which here represents the profile of the wave. But at smaller velocities of rotation, this would certainly not be the case, and the question arises whether some similar departure from perpendicularity may not present itself in the experiments of Mr. Froude.

Independently of the extreme case I have just alluded to, we have been informed by Mr. Froude that the shortness of the length of his pendulum is essential to the accuracy of the indications of his instrument. He has told us, moreover, that the centre of gravity of the large wheel, which turns on friction rollers, is slightly below the axis on which it turns; so that the wheel itself represents a slowly oscillating pendulum, in other words, a simple pendulum of great length; and the machine, unless I have misunderstood his description, may be said to record automatically the variations which occur in the inclination of these two pendulums when the wave is passing under the ship. Hence, if both pendulums alike placed themselves perpendicular to the wave surface, the instrument would obviously not serve the purpose for which it was designed. Its efficacy, therefore, may be said to depend materially upon the difference between the virtual length of the one pendulum, and the actual length of the other. I should be glad to know if Mr. Froude has had an opportunity of ascertaining the effect of altering the relative lengths of these pendulums. I have given frank utterance, Sir, to the thoughts which occurred to me as I listened to Mr. Froude's interesting paper. Those now present who, like myself, have not made such questions a subject of special study, may be glad to have the difficulties I have raised removed. To Mr. Froude this will be an easy task, for we all know with what experimental skill and large experience he has worked for a long time upon this and other kindred portions of a very important but difficult subject, a subject which up to the present time has remained, I believe, almost inaccessible to rigorous mathematical treatment.

Captain SELWYN, R.N.: Allow me to ask a question or two for my own instruction. Would Mr. Froude be kind enough to give us the explanation of the cause he assigns for the rolling of ships where it occurs in a comparatively smooth sea, and where no waves are perceptible—a case which constantly arises; and also how far the velocity of the translatory motion, whether that arises during the roll of a ship, or in such a case as the advancing surf in the drawing, how far the velocity of the translatory motion tends by the law of the composition of forces to make the pendulum assume a direction which it would not otherwise have taken. Also with regard to the cup full of water retaining a plane parallel to the wave slope, how far that would be true of a vessel of water if set on the deck of a ship—what would be the action of water inside a vessel set on the deck of a ship as compared with that which he attributes to the cup swinging in the hand which he has shown us?

Mr. FROUDE: With reference to the translatory motion of a wave, I think if you

were to place an upright post in moderately deep water traversed by a series of moderate waves, and to place a piece of cork on the water close to it, you would see actually that cork—at least I have never found any difficulty in seeing it—the cork move forward hollow at the crest and backward in the wave. I cannot say you ever see waves regular enough to show the absolutely circular motion, but you do simply see that the motion is of that character. You must recollect the translation of the profile of a wave itself is vastly greater than the translation of the particles of which the profile at the moment consists. Take the condition of an Atlantic wave, 500 feet in length, the transit of which, from crest to crest, will take ten seconds, making 50 feet per second as the speed of the translation of the profile. Now suppose the wave to be 20 feet high, so that the cork float at the surface is describing a circular orbit 20 feet in diameter, of which the circumference is, therefore, in round numbers, 60 feet, or a speed relatively so insignificant that an observer would certainly be unable to appreciate it correctly in the open sea when masked by the eightfold greater speed of the wave-profile; yet if, when the wave was passing him, he had a fixed object by which to observe its motion, he would be satisfied that the motion is at least 3 or 4 knots, as it really is, and that the top of the wave is moving forward, and the bottom of the wave is moving backward with about that speed, I won't say he could exactly count the speed by a watch, but he would be satisfied as to the character of the movement. With regard to the action of waves moving near a vertical quay wall, when the motion is *along* the wall, you do see the very thing happen. The case when the wave is approaching the wall no doubt may at first sight seem perplexing, but the fact is, that the existence of the wall converts the translatory motion of the contiguous particles, wholly, and of those nearly contiguous, partially, into vertical motion, and the increased rapidity of the up and down motion serves to disguise to a great extent the lateral translation which remains; but that it exists is quite unquestionable. If they are calculated, you will find that in all cases the actual translations are such as to correspond with the deflection of the pendulum, in virtue of the composition of forces, no less in the very flat waves which Captain Selwyn referred to, than in those of larger elevation. The composition of forces governs the result wholly. The forces to be compounded are gravity, which, strictly speaking, must include the vertical translatory forces due to such up and down motion as there may be, and the horizontal translatory forces due to such lateral motion as there may be. If you place a bucket of water on the top of a piston rod, and make the piston ascend and descend, then while the bucket is being accelerated upwards, there is an intensification of gravity in the water; when the bucket is being accelerated downwards, there is a diminution of gravity in the water, and you might make the acceleration so great that the water would be left behind altogether, and in that condition when gravity is neutralised by the downward acceleration, the water particles are in a perfectly neutral condition so far as mutual pressure is concerned. The water rising and falling up and down the face of a quay wall is very nearly in that position. It is thrown up, it is losing upward velocity and gaining downward velocity as fast as gravity can urge it, and therefore a very small lateral translation satisfies the condition that the surface of the water shall be at right angles to the compound of gravity and translatory force, even when the surface appears almost perpendicular. I do not know whether this explanation seems sufficient, but if you watch the phenomena by light of the explanation, I think they may be more correctly apprehended, and, as I have said, if you plant a small post in the water for the waves to wash past, you will see the very thing happening.

I think there is a little misconception in supposing that the mechanically rigid surface of that wheel can be taken to represent the living curvature of the hollow of a wave. Even were the wave-profile circular, that circle would not be the orbit of the particles. Even if the wheel were rotating, the pendulum would not hang normal to its circumference, nor if you were to put a drop of water on the circumference, would the water stay there. The pendulum might become horizontal in some part of the rotation, were the velocity sufficient, and the same circumstances would keep the water-surface in an upright condition, which would keep the pendulum in the horizontal condition. The length of the pendulum is important only because a very short pendulum is capable of at once assuming that position which is for the moment its position of equilibrium; a long pendulum, if not in that position, would be so long

assuming it that it would set up an independent oscillation. The short pendulum so instantly gravitates in the direction which is its momentary position of rest, that no time is lost. If you put a spirit level on a raft, if you put a marble in a floating saucer, and put them on regular shaped waves, the marble should not roll about; the bubble of the spirit level should remain at rest; the fluid in the spirit level is but as the fluid which surrounds the spirit level. Imagine a raft consisting of bamboo canes on a wave slope, you would be surprised to see the water running down through the canes; in fact, if a tube floats like a spar, pointing up a wave slope, the water should surely remain in it as inert as it appears to be in the rest of the wave-surface; yet the water is not really inert in the wave slope or in the tube, for the steady slope bears witness to the forces by which it is being urged.

The Chairman: I am sure you will wish me to thank Mr. Froude in your name most cordially for having so clearly explained a very difficult subject, for every Naval Architect and every seaman must feel it is one of the most important subjects that can be investigated. It is only during a very few years that the question of the theory of wave-oscillation has been scientifically and experimentally entertained at all. I suppose we could count on our fingers the men in Europe engaged in this investigation, and of these Mr. Froude stands almost foremost. We know the great difficulty there is in obtaining accurate records of a ship rolling. It is a matter of the greatest practical and scientific importance to the Naval Architect and the seaman in determining the disposition of the weights in a ship. We all know that it is practically a very great difficulty to ensure that the oscillations of a ship in a sea-way are truly recorded, and if this instrument assists us in accomplishing that object, and I fully believe it will do so, we cannot overrate its value, for it will enable our Naval Architects to deduce laws from the facts thus recorded, that will be of the greatest value to them. As regards the determination of the wave-slopes, I share with Captain Colomb the feeling that I am only learning this evening, and I cannot say I thoroughly have understood all we have heard, although Mr. Froude has made it so clear, but it appears to me one of the great values of ascertaining the wave-slope in connection with the angle of heel, is that you make your curve of stability of great importance in enabling you to ascertain the righting force acting on a ship when rolling, which the curve of stability in ordinary cases enables them to do when inclined in still water; but without knowing the angle of the wave-surface, the righting force cannot be ascertained. I have shared the difficulty that I heard expressed by Dr. Hirst as to the question of the inclined position of the pendulum, but I am ready to put faith in Mr. Froude, and only hope that he will be enabled by taking his instrument to sea to carry out his experiments further, and to prove to our satisfaction that what he says on that point, really exists. I may make one remark on it which perhaps may show how little I do understand the question. I cannot recognise that the pendulum can remain in the position of a normal to the wave-slope, except with some definite velocity of translation of the ship and a definite length of the pendulum. Experiment may satisfactorily prove that I am mistaken; but I should imagine the velocity of the translation of the point of suspension, and the length of the pendulum, were elements that must be taken into consideration.

Mr. Froude: It is because the ship is being translated by the wave at a certain rate, or rather because its translation is being altered at a certain rate, that the pendulum is deflected. The proposition is that there is inherent identity between the causes which govern the slope of the water-surface and those which govern the direction of the pendulum.

The Chairman: There is another point that I have no doubt experiment will prove. It is this: that that representation of the float partakes entirely of the motion of the surface, whereas a ship drawing 4 or 5 feet of water cannot entirely partake of the motion of the surface.

Mr. Froude: The diminution of the motion in the underlying water no doubt somewhat lessens the effective wave slope, which is thus different from the surface wave slope; the action is a compound action. I speak of the surface generally, merely by way of expressing the general laws which are in action without going into the complexity of the internal mechanism of the wave; this alters slightly the measure of the results, but does not alter their character.

The Chairman: I beg to offer Mr. Froude the most cordial thanks of the Council and audience for his most interesting paper.

Evening Meeting.

Wednesday, April 9th, 1873.

Rear-Admiral Sir ASTLEY COOPER KEY, C.B., F.R.S., President of the Royal Naval College, Greenwich, in the Chair.

ON THE ACCURATE FIRING OF NAVAL ORDNANCE BY MEANS OF THE VESSEL'S MOTION.

By H. Bessemer, Esq.

Before commencing to read my paper, with your permission I will make one or two remarks on the models which I brought here on Monday evening last, as they serve further to illustrate the very admirable paper read to us by Mr. Froude. He, as you know, read a most elaborate and able paper on "wave-motion," and a mode of recording it. The instrument which I have constructed, and to which I refer, had not that object, but was simply intended to record the motion of the deck of a ship, that is to say, the amount of roll, and the amount of pitch of the vessel. In my own particular case, the invention had reference to the "still-cabin," which, as you well know, I am proposing to make for ocean travelling. For that purpose, I did not require that the instrument should be able to indicate through so great an angle as is necessary with the instrument produced by Mr. Froude, and some differences in our apparatus necessarily resulted, in consequence of the different objects we had in view. The first instrument which I proposed for this purpose was simply a curved spirit level. Here the tube, which is usually straight, is curved to an arc of 28 inches and $\frac{5}{8}$ths in diameter, giving quarter-inch divisions for each degree of the circle. The smallest roll of the vessel allows the air-bubble to play along this curved tube, and to present itself opposite each of these divisions, whether it be in one direction or the other, and a person observing it, is able to read off there and then, the angle through which the vessel is rolling. I wished to be able to indicate what was the actual difference between the rolling of the saloon as

constructed by myself, and the rolling of any other part of the vessel at the same moment; therefore an instrument in each place would have indicated accurately those differences. However, I found that a small amount of time is occupied in the traverse of the bubble, even for the short distance of $\frac{3}{4}$ of an inch, because it does not move until a change of level has taken place; hence I was very desirous of making an instrument that would indicate instantaneously the slightest alteration of the level of the saloon, and for that purpose I constructed the one we have here, and which owes its power of registration not at all to the same principle as the spirit level, but simply to the *vis inertiæ* of a large mass of metal.* I was very much struck and surprised to find on my entrance here on Monday evening, that Mr. Froude had adopted precisely the same means, and had carried out those means in the most perfect manner imaginable. The fly-wheel that he employed, had an axis of an inch in diameter, and rested on large segmental quadrants, which gave to it an exceedingly small amount of friction. In my case, as I only required to register one degree of motion—for I hoped to confine the cabin to an extreme range of only one degree horizontally—I have a means of indicating one degree, by a traverse of 3 inches, and the indicator will show the smallest amount of that motion; so that the instant the smallest deviation from the true horizontal line is given, the man controlling the apparatus has notice of it, and would be able to check it momentarily. I may say that this in reality is a pendulous body, although I speak of it as a large mass having only the *vis inertiæ* of its bulk to keep it from motion. By turning this screw a little, a cylindrical mass is projected from its under surface. While it remains in coincidence with the surface, the mass is in perfect balance, and is a portion of a perfect sphere; but the moment I begin to operate upon it, I project a pendulum. I have now projected it about $\frac{1}{8}$th of an inch; this is now a pendulous mass, but surrounded by so large an inert body of matter at its centre, that the portion projected does not tend to put it in a state of vibration. This instrument can be now swung backward and forward without the small protruding portion of metal having sufficient power to carry the mass with it. At the same time the tendency for the mass to hang vertically below the centre, is just sufficient to prevent any accidental imperfection of the axis from gradually getting it round to one side or the other, so that in reality this line of the screw which passes through the pendulum, is always kept vertical, however much the base may roll. This is precisely the principle involved in Mr. Froude's beautiful machine. The only difference is that he placed his fly-wheel eccentrically, some $\frac{6}{1000}$th part of an inch, which gave it a slightly pendulous action, while I, by protruding a pendulous mass can restore it to an absolute balance, or project it to any minute increment beyond that distance, that may be found desirable.

There was one other point in resemblance, which is a curious coincidence, because the machine of Mr. Froude's was one thoroughly elaborated, and one certainly of very great mechanical merit, though I was

* Diagrams, and an explanation of this pendulum will be found at page 899.

somewhat disappointed to find that he did not dwell upon that point. Indeed the first part of his paper was so interesting that he could hardly come to the details before he found the time was sliding away from him, and he omitted the latter part, which I presume dwelt more upon the details. You will remember he exhibited on one side of the machine a tracer with a very long horizontal pendulum, a thing, I believe, absolutely new. But it is curious that in the course of the investigations which I have now going on, I have employed two pendulums (made a year and a half ago), for the purpose of that very experiment. Here we have these two little pendulous bodies which never know when to cease vibrating, from the shortness of their axes. It was a matter of considerable surprise to me to find that this should have been so cleverly and so usefully introduced into the beautiful machine of Mr. Froude's. Having explained these models, I will now read my paper.

The British Navy has achieved so enviable a position before the world as to have attracted to itself and absorbed among its own members many of the most able and scientific men of the day, who, by their combined talents, have well sustained its high position; but while doing so, they have created so deep an interest among those who have not the honour of being connected with the profession, that numbers of persons wholly outside the sphere of its immediate attraction, have nevertheless been irresistbly drawn into the great vortex which requires and absorbs so much of the latent talent of scientific men.

Thus it is that I find myself as a mere outsider, taking so deep an interest in the science of naval gunnery, notwithstanding that my entire want of professional knowledge should have warned me that I was treading on dangerous ground, and at every turn liable to fall into grave mistakes; hence I must throw myself on your indulgence in venturing to bring before so many able naval men a proposal to improve upon a science, so many of the details of which I am totally without a knowledge of.

No one, however far removed from the profession, can have failed to note the great change which has come over the art of naval warfare within a very recent period. The employment of steam power in lieu of sails, the iron armour-plated ship, which now takes the place of our wooden walls, and the employment of heavy rifled ordnance in lieu of our old eighty-fours, have so revolutionised the naval profession as to have left but few of the old landmarks visible; indeed, it would seem that the whole profession has had to be relearned, and thus, with its ever-increasing changes, it now affords an opportunity, even for outsiders, to offer an occasional suggestion for its improvement.

The employment of war vessels of the new type, carrying very few guns of large calibre, instead of a large number of small ones, renders it very desirable that those which are employed should be handled with the greatest facility, and that every shot fired from them, as far as practicable, should be made to tell; at least this is the view which I, as a non-professional man, have taken to be one of paramount importance.

Among the most remarkable effects of our modern rifled artillery is the extreme accuracy obtained when firing from a steady platform on shore; the results thus attained have served most forcibly to illustrate the extreme *inaccuracy* of firing with the same class of gun from an unsteady platform at sea, where the advantages of the high perfection and precision of modern rifled artillery seems almost wholly lost.

It is now more than three years since the disadvantages of an unsteady platform in passenger vessels was forced on my attention by a severe illness produced by crossing the Channel in rough weather, and almost simultaneously with my earliest attempts to lessen the causes of sea-sickness, the idea of a steady platform for guns forced itself on my attention, but without however inducing me to pursue a branch of the subject with which I had no immediate connection, I nevertheless described in my Patent of June, 1870, a mode of supporting guns on a movable platform, capable of being controlled and retained in a horizontal position by hydraulic machinery, similar to that by which I propose to govern the suspended passenger saloon; but on a more mature consideration of the question, I perceived that there would be considerable difficulty, if even it were possible to obtain a platform so uniformly horizontal and steady as to really represent a platform on shore. With this want of confidence, the matter was left until very recently, when the public discussion of my steady saloon for passenger steam-vessels attracted the attention of Colonel A. Strange, who, wholly unaware of what I had proposed in reference to gunnery, re-invented the steady platform for guns, governed by my hydraulic apparatus; and on which subject you will remember that Colonel Strange read before this Institution a most interesting and able paper a few months ago.

The importance of a steady platform for guns at sea had sufficiently forced itself on my attention, in 1870, to prevent it from being entirely forgotten; hence the subject, from time to time, continued to occupy me until January, 1871, when I first conceived the idea of utilizing the motion of the vessel, and making it the unconscious agent by which a gun may be fired at any desired angle of elevation, and thus, in lieu of struggling to obtain a quiet platform, I sought to bring the restless enemy, not only under subjection, but to make it an unwilling instrument in bringing about that amount of accuracy of fire which, from the earliest days of marine artillery, it had so persistently counteracted.

Let us now suppose a broadside gun about to fire at a vessel a quarter of a mile or 440 yards distant from it, and that the vessel on which the gun is placed rolls to an angle of six degrees, and that she makes eight of these rolls per minute, it follows that at every such roll the gun will be directed to a point 69 feet above and 69 feet below the centre of an arc of 138 feet, described at a distance of 440 yards from the muzzle of the gun. This gives a mean speed of 36·8 feet per second, at which the imaginary arc is described; so that for one-third of a second of time only, does the gun cover the 12 feet in height of the side of the enemy's vessel, even when it is within a distance of only 440 yards. Need it then be a matter of surprise that our most expert gunners under such circumstances make what would be very bad practice on shore,

but which is nevertheless a perfect marvel of skill under these adverse circumstances.

Now it occurred to me as a necessary consequence that as the gun at every roll of the ship points so many feet above and below the part which we desire to strike, that at every such movement of the vessel the gun must necessarily point precisely at the desired spot, and if we could only ascertain the right moment to fire, that our practice at sea would be as certain and effective as it is on land; and further, that all which is necessary to accomplish this object, is to confine the skill of the naval gunner to the training of his gun, and to the employment of his knowledge as an artillerist, in determining the proper angle of elevation to fire at, and to furnish him with an instrument which would itself fire the gun with unerring certainty at any number of degrees and minutes of elevation at which it may be set, leaving him to choose the time for putting the apparatus in operation. This, then, is the instrument which I propose to employ, and which is shown in front elevation on the diagram, Fig. 1, and in side elevation of Fig. 2, a portion of both diagrams being in section. I have also an instrument so constructed on the table before us. The instrument may be placed upon or near the gun, with its base-plate in the same plane as the chase of the gun (which will not require to be altered).

On the base-plate, A, the table, B, is supported on an axis, C, resting on Plummer blocks, D. The central part of the table is filled with a block of vulcanite or other non-conductor of electricity, E, and carries in its central part, a grooved strip of brass, G, which is, therefore, insulated. The block of vulcanite also serves to support two brass arms, H and I, between which is an inverted pendulum, J, resting on knife edges at its lower end, which are inserted in the groove formed in the piece of brass, G. The pendulum, J, is much widened at the foot, as shown at J*, Fig. 2, and is thus prevented from falling out of place, but it is nevertheless free to move to or from the supports or arms, H and I.

On the same axis as the table, E, a graduated quadrant, K, is mounted, the curved edge of which is in gear with the micrometer screw, L, by means of which it is made to carry the table, B, over with it to any desired angle of inclination. It will be observed that the bed-plate, A, also serves to support a frame, M, in the upper part of which the axis of the micrometer screw works. This axis carries on one end a milled thumb-screw, N, and at its opposite end a small disc, P, divided into sixty equal parts or minutes. The quadrant has engraved upon it a central zero, and twenty graduations in each direction from this central point. These are simply degrees of a circle divided into 360 parts; thus, one revolution of the micrometer screw moves the quadrant exactly one degree, while the divisions on the disc, P, each mark one-sixtieth, or one minute of a degree. It has been thought quite unnecessary to make any further division of the arc into seconds, as one minute of a degree alters the point where a shot should strike only $4\frac{1}{2}$ inches at a quarter of a mile distant. A small galvanic battery is employed, and one of its conducting wires is inserted in a stud (see Fig. 2, which forms part of the grooved piece of brass, G), and thus, com-

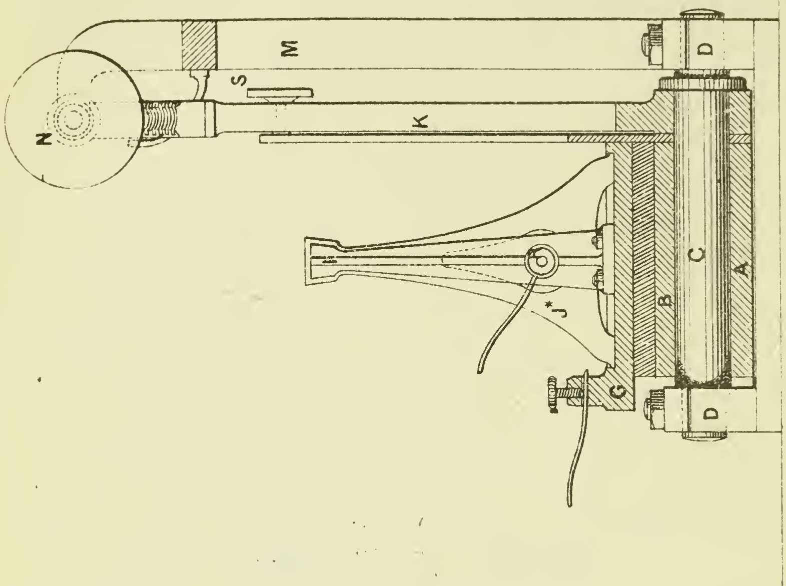


Fig. 2.

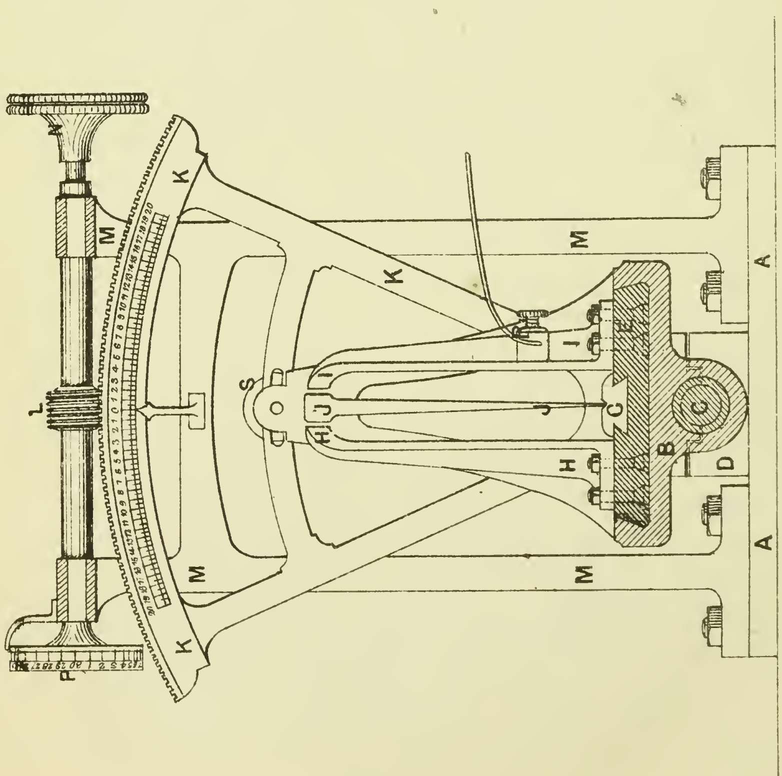


Fig. 1.

J. Jobbins.

Pl. L

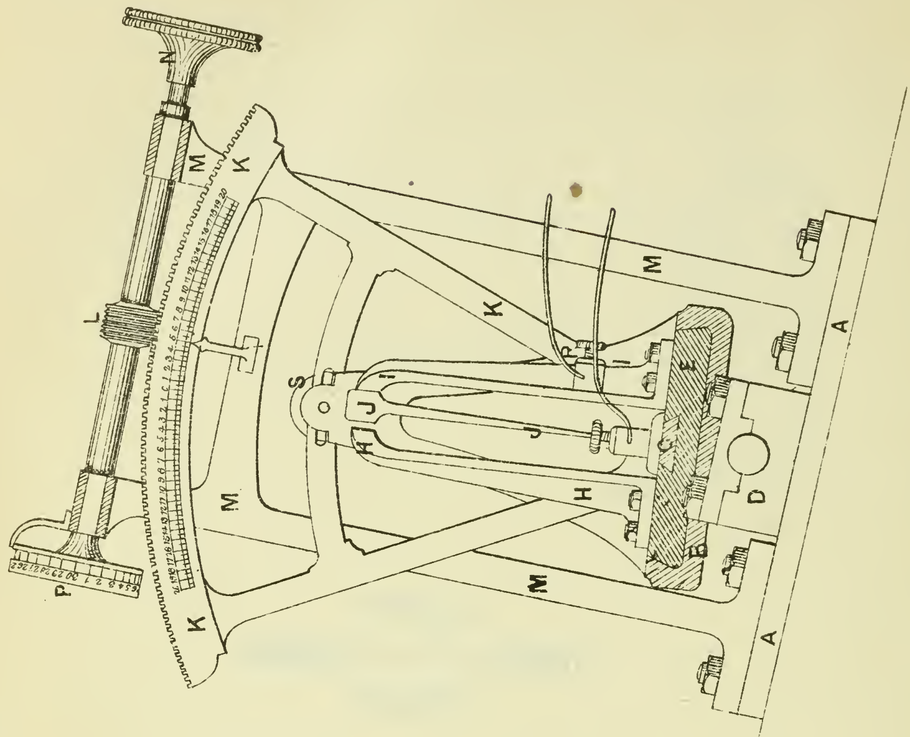


Fig. 4.

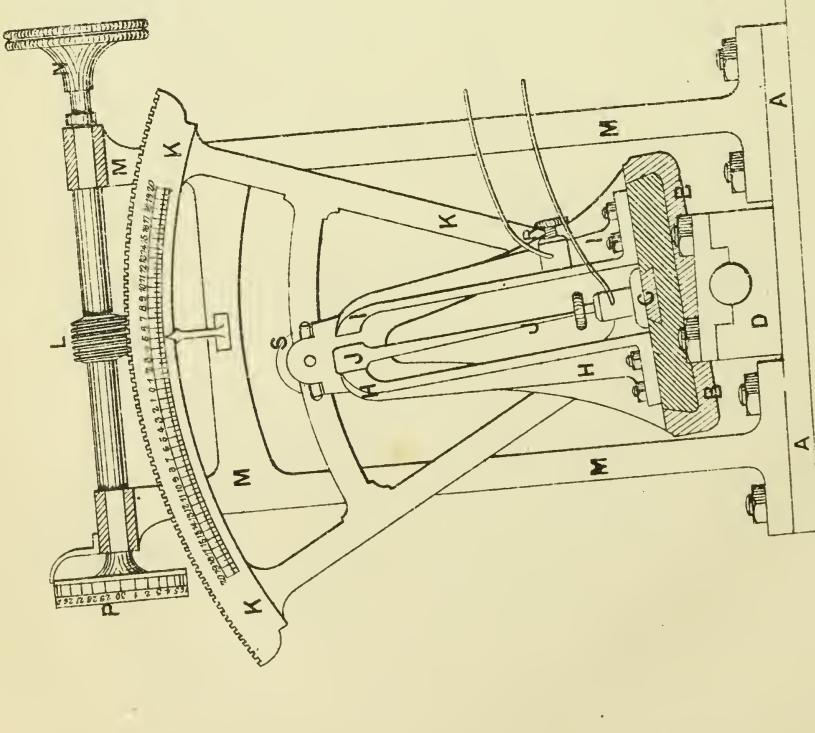


Fig 3

J. Jobbins

municating with the pendulum, a similar wire attached to the stud, R, on the arm, I, communicates with an "Abel's Fuze" in the gun, and from thence again to the battery.

A small movable spring knob is placed in convenient proximity to the gunner, and will, on being pressed upon, make good the connection with the wire leading from the battery to the pendulum, but this spring knob will always leave that connection broken except when it is pressed upon.

Such being the arrangement, it will be understood that with every roll of the ship the pendulum resting against the arm, H, will be brought up to a vertical position, and will then immediately fall over against the opposite support, I, and in doing so will at the moment of contact, establish a direct metallic communication between the battery and the fuze, provided the spring firing-knob is being pressed upon, and not otherwise. But whenever the instrument is in the position shewn in Fig. 3, the pendulum, J, resting against the arm, H, cannot communicate with the fuze, because this arm rests on the vulcanite, and is insulated; but whenever the pendulum passes the vertical line as shewn in Fig. 4, it falls over and rests against the arm, I, and instantly fires the gun. It will be observed that the instrument shewn in Fig. 4, has its quadrant turned to an angle of 5 degrees, and it is not until the base of the instrument rises to this angle that the pendulum can fall over; and as the base of the instrument is coincident with the plane of the chase of the gun, the discharge will take place at that angle of elevation, and at no other: thus as soon as the gunner has determined at what angle he desires to fire, and has moved round the micrometer screw, until that angle is indicated on the instrument, he may discharge the gun, or he may continue inactive as long as he pleases, meanwhile every roll of the ship will cause the pendulum to make and break contact, but all to no effect until he presses the firing knob, and thus joins up the remaining link in the connection between the battery and the pendulum. Here it must be specially observed, that the act of pressing down the firing knob does not discharge the gun there and then, but paves the way for its discharge by the falling pendulum, which only obeys this summons when the chase of the gun has arrived at the precise angle indicated by the instrument.

Now the instrument, so far as I have hitherto described it, is subject to two sources of error, which are provided for in the following manner:—

Firstly. It may be observed that a pendulum falling freely through the space of $\frac{1}{4}$ of an inch, occupies a small space of time in so doing, during which the roll of the vessel continues to alter the angle of the gun's elevation; and secondly, there is also a small period of time during which the shot is traversing the chase of the gun after the powder is ignited, and during this period also, the roll of the ship continues to alter the elevation of the gun. A second movement on the instrument is provided therefore for the correction of these two sources of error, and is effected by means of a thumb screw, as shewn at S.

From actual experiment with the gun, this loss of time can be correctly ascertained, and a correction must be permanently made on

the instrument whereby the zero or horizontal point is no longer an absolute zero, but a working zero; the instrument will then indicate, not the angle at which the pendulum will commence to fall over, but the actual number of degrees and minute of elevation of the chase of the gun, at the precise moment that the projectile is leaving it, and thus afford the gunner at sea the same opportunity of hitting the object aimed at, as he would have after taking a most deliberate aim with a gun mounted on a fortification, and carefully directed on a like floating object.

I desire further to observe that the instrument I have placed before you although sufficient in size to fire the largest artillery, may perhaps be preferably made much larger and coarser than this one, an instrument in fact consisting of a strong cast iron frame bolted down to the floor alongside the gun, and capable of sustaining rough usage without injuiry.

Further, I would observe that an instrument which I call a "motionless pendulum," devised for the purpose of governing the ship's saloon, may also be made use of in lieu of the inverted falling pendulum, because its indications and action upon objects in motion, are more rapid than the instrument I have just described; indeed it will be obvious that many modifications may be made of this instrument depending on the broad principle of my invention, viz., the firing of ordnance at sea, at any precise and pre-determined angle of elevation, by means of the rolling, or pitching motion of the ship, totally irrespective of the extent of such movement.

There are two other points which I conceive to be necessary in order to complete the proposed system of accurate firing at sea.

Firstly. I propose to use an hydraulic apparatus capable of most easy control by a sort of steering-handle similar to that which I employ for the control of ships' saloons, and by means of which the gun may be so trained, that the line of fire shall at all times pass to and from a point vertically above or below that part of the vessel which the gunner desires to strike, irrespective of the varied motions of the ship on which the gun is carried. The instrument employed for firing, may be placed alongside the gun, and have its base-plate pivoted so as to form a sort of turntable, having a rod to connect it with the traversing carriage of the gun, so as to retain the relative positions of the pendulum and gun always the same, and thus insure its perfect action.

Secondly, I consider it necessary that the gunner should be provided with an instrument capable of measuring rapidly the exact distance of objects at sea. I had devised a very simple instrument for this purpose, and it was included with two others in my application for a patent for the instrument now before you.

But these instruments were considered by the Solicitor-General to be separate inventions, and he required that I should take out separate patents for them, although they each formed part of a system of accurate firing at sea. The result was that I only took out a patent for the one instrument now before us, and the others have in consequence only been partially developed. The instrument for measuring distance, consists of a trigonometrical arrangement combined with a powerful field-glass

on which a micrometer screw and index show in plain figures, and without any calculations, the number of yards distant of a ship, by simply turning a thumb-screw while observing the distant object. The time required to make an observation would be about thirty seconds, and this might be called out to the gunner continually as the vessel advances or recedes. From a rough trial I should say that it would indicate objects at half a mile distant with an error not exceeding three yards.

I am thus led to believe that, with the self-acting apparatus to discharge the gun at a determined angle, guided by an efficient instrument for indicating the distance of the object fired at, and with the hydraulic apparatus for continuously training the gun, a degree of accuracy in firing at sea would be achieved, that the utmost skill of our best naval gunners must for ever fail to reach under existing conditions. Now also that our guns are reduced to so small a number in every ship, it appears to me of the highest importance to the service, that every available means should be employed that can assist the gunner in rapidly manœuvring the gun by the application of power, so as to save labour, to reduce the number of valuable lives exposed, and to neutralize, as far as practicable, the sources of error in training caused by the motion of the vessel, and in determining the exact instant for firing by a properly constructed instrument; for it must be of immense advantage to deliver the first blow, and to follow it rapidly up by others. Indeed if we could succeed in doubling or trebling the number of effective shots, it would be equivalent to an equal increase of the number of guns and the actual force of our Navy, the importance of which question no persons are so well qualified to judge of, as the gentlemen whom I have had the honour of addressing.

Vice-Admiral Sir Spencer Robinson, K.C.B.: Of course the gun in this case is to be laid horizontally? The motion of the ship is to give the elevation, to be determined by that screw (*pointing to it*), and whenever the motion of the ship gives the elevation necessary, the gun is then fired automatically?

Mr. Bessemer: That is the arrangement precisely as it stands, but it does not necessarily follow that rule, inasmuch as if it were necessary to fire when a ship was rolling only one or two degrees, and you wanted a third degree of motion upon it, you would place the angle of your gun so that the two degrees of motion would include within it the degree at which you must fire.

Sir Spencer Robinson: I should like to address a few remarks to the meeting upon this most interesting subject. I say it is a most interesting subject, because I am sure all of us must feel that the invention of an instrument of this kind to do away in some measure with the uncertainties of naval ordnance discharged under motion at sea, is an enormous gain to the naval service, and at any rate, whether a gain or a loss to us nationally, will have upon naval tactics, upon the results and conditions of naval warfare, a most extraordinary effect. There are none of us who I think of late years have considered the subject, but have been overwhelmed almost, by the immensity of chances against the terrible projectiles which we are prepared to discharge, hitting the object at which they are aimed. It has seemed to me, on reflecting on these subjects through a considerable period of years, that we have incurred a very great and incommensurable amount of uncertainty as to the effects of naval ordnance at sea. We have reduced the numbers of the smaller ordnance which were formerly carried, 32- and 68-pounders, and have culminated now in that 35-ton rifled gun, shortly to be superseded by a 50-ton gun. (If the artillerists can succeed in building such a gun to their satisfaction, there is no doubt we shall

shortly see it.) The effect of diminishing the number of guns, is that it is obvious in a naval action the chances of our projectiles hitting are diminished in inverse ratio of the power of the projectile when it does hit. We shall deliver the most frightful blow from the 35-ton gun; we shall deliver a blow that hardly any structure can resist; but we shall deliver that blow slowly, and we have not made as much progress in certainty of hitting with that tremendous projectile as we had formerly by a discharge of from ten to twelve 68-pounders. If our shot is not thrown away, the effects will be destructive and final; if our shot is thrown away, a long time will elapse before we shall be ready with another, which also may fail. To my mind, the influence of this hazard of not hitting, on naval tactics and constructions, is very great. Naval battles will be fought, as I conceive, at sea, under conditions of rapid motion through and rapid motions upon the water, and therefore under circumstances in which artillery must be admitted to be uncertain, and it is probable that the most efficacious mode of destroying an enemy will be, by the fearful impact of one of these vessels against another. However, I was very much struck by the wonderful adaptation of mechanical thought that Mr. Bessemer has displayed in the admirable machine that he has put before us. He has, if I may so say, eliminated one of the great difficulties of this subject, one of the great causes why the effect of naval artillery is likely to be considered very uncertain—he has eliminated one of those great causes by inventing a machine which will evidently discharge a gun at the exact moment that we have got the elevation that is required for propelling the projectile through the space it has got to travel, and causing it to alight on the object it is aimed at. That we know was by no means an easy matter in former times, and upon that, upon the right elevation of the gun and upon its being discharged at the right angle of elevation, a very large and important part of the chances of hitting the object, as we all know, depends. The procuring a right direction of fire is not so difficult. Discharging the gun at the due elevation, when elevation is required for a projectile to go to its mark, is no doubt a considerable difficulty under motion. It appears to me that the whole subject is so perfectly thought out, that no merely mechanical difficulties will prevent the success of this machine, and that the plan Mr. Bessemer has brought before the meeting to-night, will no doubt be perfectly effective in discharging the gun with the elevation it ought to have. If that be combined with the exact knowledge of the distance, so that the elevation is really what it ought to be, we have eliminated a very large source of error from the discharges of naval ordnance, and naval ordnance of large calibre may be looked at with more satisfaction than we can look upon it under the present knowledge of the uncertainty of its results at sea, because the loss of time in loading these large 35-ton guns or, supposing we get it, in loading a 50-ton gun, and discharging it, would be very considerable. The rate at which ships approach each other has now become something enormous. We know that we possess ships capable of going within a very few decimals of 15 knots an hour. Our neighbours possess ships capable of travelling at very much the same speed, and ships approaching each other at 30 miles an hour leave us but small time for more than one discharge, and if that discharge fails, the combat resolves itself almost entirely into impact. Like the knights of old, we shall probably retire and charge again. If, as I say, we get over the uncertainty under which we now labour of discharging the gun at the exact moment it has the proper elevation, we have eliminated one very great source of uncertainty from the action of naval ordnance at sea: we shall feel greater satisfaction at having thrown away numerous pieces of small artillery and adopted pieces of enormous dimensions, slow in their fire, but most formidable and most deadly in their effect. I think the subject is well worthy of the attentive consideration of this Institution, and it occurs to me that Mr. Bessemer has brought before us something which will be of very great value in deciding, not only on the forms of our ships which, after all are nothing but floating gun carriages, but upon the nature of the gun itself, and in bringing out a fact that will give us an assurance that we are not altogether wrong in constructing those huge pieces of ordnance, whose effect will so greatly depend on the success of these inventions that he has brought before us. I attach very great importance to the small machine he described for letting us know the exact distance we are from our opponent. I think we shall derive the greater benefits from the perfection of such instruments as these, the larger the ordnance we

employ. They will enable our artillery to be directed with more confidence of hitting the object under the rapid motion of the ship and at the extraordinary angles at which the projectile must at times leave the gun than we can possibly have at present, even when we are in the hands of the very best and most skilful artillerists. I go further also in this view. It seems to me the more we follow out progressive science, the more we investigate the causes of all that passes under our observation, the more we come to this conclusion—that when we can bring well-conceived machinery automatically to do the duty that we wish to put upon the nerve, upon the skill, upon the brain, and upon the teaching that any man has received, the more we eliminate error, and the more nearly, we approach perfection. I have seen within the last few weeks some very remarkable proofs of how matter taught by mind can do things which mind alone cannot do. I listened with the greatest interest the other day at the Institution of Naval Architects to the description of that model for ascertaining the rolling of ships, given by Mr. Froude. I see in the instrument that Mr. Froude has invented and in the one that Mr. Bessemer has put before us, proofs of the enormous power of direction, that a mechanical mind has over matter, and of controlling that matter by mathematical reasoning. We remember the wonderful way in which the late Mr. Babbage used mechanical means to solve some of the most abstruse problems in the philosophy of arithmetic by a calculating machine. When we see these automatic machines, by which a gun can be discharged with scarcely calling for the operation of a man's mind—that the gun itself when put into position by the ship's motion will be discharged at a given object at precisely the elevation at which that object can be hit—when we see that mechanism can be applied to calculation, that mechanism can be applied to register with the greatest accuracy, not only the rolling of the ship, but to describe actually the path of the wave and the influence of that wave over the ship's motion, I think we must all feel the greatest possible desire not only to encourage, but to take part as far as we possibly can, in these applications of the reasoning powers of men to mechanical applications, remembering that it is thus that large and important addition to our powers of acting on the forces of nature will be given to us. Before I sit down I must say that amongst all the things that have given me pleasure, one that I have the greatest delight in recalling is the fact that a Naval College or University has been established, in which all such inventions will in the course of time be brought before the rising generation of naval Officers, and also that that University will be under the presidency of a naval Officer whose talents and abilities to fill the particular post, are well known to us. I am delighted to think that amongst the memorabilia of Mr. Goschen's administration—be they few or many—there is at all events this one, which will be appreciated by all who value knowledge, instruction, and the powerful influence they will exercise over the minds of youthful followers of the naval profession. Nothing that Mr. Goschen has done will redound more to his credit than the establishment of the Naval University and the appointment of the Officer to whom he has entrusted the Presidency of that University. I am sorry to have occupied your time so long, but having thought very much upon these subjects, and having myself felt the disadvantage of an imperfect naval education in these deeply interesting matters, I could not but congratulate you on the prospect there is before us of a better system of instruction being afforded to naval Officers. I must again express the value I attach to inventions such as Mr. Bessemer and Mr. Froude have brought before us, as showing the power of thought to overcome mechanical difficulties. I am delighted first of all that we have such an Institution as this one, and next that gentlemen like Mr. Bessemer and Mr. Froude will come and explain these things to us, and if I have taken up your time in talking about matters of such grave importance I must ask you to excuse me, for it is the fulness of the delight with which I have witnessed these things, that has compelled me to trespass so long on your attention.

Captain Goodenough, R.N.: It would be quite impossible for us to attempt to discuss the invention of Mr. Bessemer, any more than we could that of Mr. Froude, the two papers describing those inventions being the very last expression of science in the several directions in which they go. There is, however, one question that I should like to moot, in order to clear up a point on which Mr. Froude spoke to us the other day, because it seems to me that Mr. Froude and Mr. Bessemer are not perfectly at

one. We understood the other day from Mr. Froude, and I think we all accepted it on his authority, although we were hardly able to follow the whole of his very close and perfect argumentation, that the action of translation of a wave, of what he called the mean or virtual undulation of the wave, was such as to render anything in the nature of a pendulum, an inaccurate instrument; and, although in the instrument which Mr. Bessemer has applied for the laying of the floor of his cabin, that is (to speak in general terms) to a great extent counteracted by the great mass of the weight of the pendulum which he uses; still in this small instrument used for the firing of a gun, there is undoubtedly a pendulum of certain length of radius and of no very great weight, which is to be acted upon by the forces of gravity and wave-motion, in order to fire the gun. It appears to me that the motion of that pendulum will not be strictly normal to the required angle, that it will not fall or move from one side to the other, when it is truly vertical to the surface of the earth, if Mr. Froude's theory is correct, as we assume it to be. I do not mean to say that this will seriously or in any very great degree interfere with the firing of our ordnance at sea, because, as a matter of fact, we do not expect ever to fight an action requiring very accurate firing in such a sea as would give the ships any considerable motion of translation. Still, theoretically, it would appear that there is a divergence between Mr. Froude and Mr. Bessemer, and I dare say Mr. Bessemer will kindly explain it.

We should be very much obliged to him also if he would kindly allow a section of that globe to appear with the printed report of the lecture.

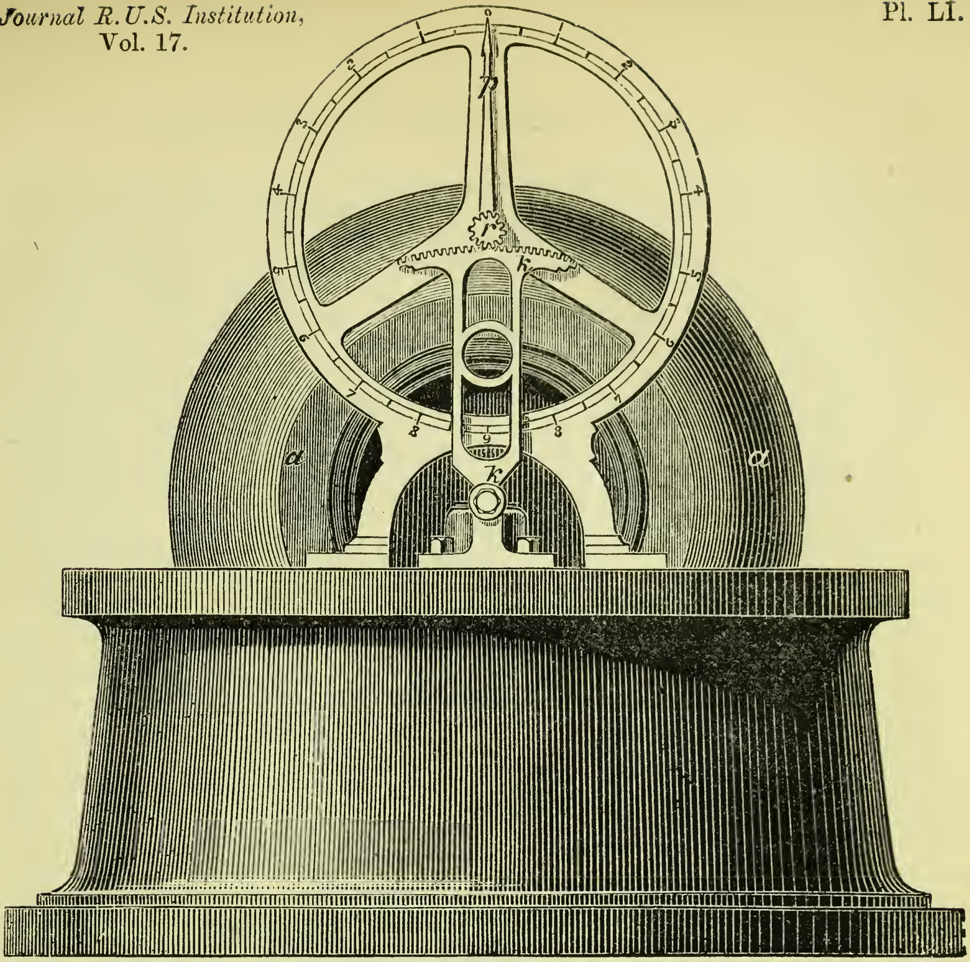
Mr. Bessemer: If you will allow me, I will sketch a section of the apparatus on the board for you, and give an explanation of the point raised.

A cylindrical mass of metal, *a* (Plate LI), is mounted on an extremely small axis, *b*, composed of a polished steel wire, secured at both ends in the main axis of the mass, *a*. On the lower side of the mass of metal so suspended, is fitted a sliding weight, *c*, capable of being drawn up into the mass, and, when there, entirely filling the cavity, *d*, so that the mass of metal then becomes as completely balanced as it would have been, had no such sliding weight been provided.

You will perceive that the screw, *n*, passes vertically upward through the axis of the mass, *a*, having a collar at *e*, and a square end, by means of which it may be turned round, while its lower end is screwed into the sliding weight, *c*.

Now, if we suppose the cylindrical mass, *a*, to be for the moment taken away, we should have the weight, *c*, remaining suspended at the lower end of the screw, *n*, and capable of oscillating on the axis, *b*, after the manner of an ordinary pendulum, in which state it would (if on land and undisturbed) simply gravitate, and come to a state of rest with the centre of gravity of the weight hanging vertically beneath a line drawn through the axis, *b*. But on board ship the axis of the pendulum, like all surrounding objects, is subject to a motion of translation, produced by the rolling of the ship. Thus the point from which the pendulum is suspended would be no longer retained vertically above the centre of gravity of the weight, which would, in consequence, move in a direction necessary to recover its wonted position beneath its points of support. In doing so, it would acquire an amount of momentum sufficient to carry it beyond the desired point, and thus set up a series of oscillations which would continue so long as the translatory motion of the vessel lasts (and which in fact are continuous): hence all attempts to make a simple pendulous body freely suspended on shipboard, an useful indicator of the plane of the horizon, is impossible.

In attempting to modify the construction of a pendulum to escape these difficulties, I have suspended the instrument in water, which had the effect of greatly reducing its violent erratic motions, but, nevertheless, the old fault remained, though in a minor degree. It then occurred to me that this too easy movement of the pendulum would be lessened if I surrounded the axis with a heavy mass of metal in a state of perfect equilibrium, the *vis inertiæ* of which would to some extent oppose the too free action of gravity on the pendulum. This idea carried to its fullest extent is exemplified in the instrument before us, where the weight, *a*, entirely surrounds and absorbs, as it were, the pendulous body, *c*, so that when the latter is drawn up entirely within the cavity, *d*, the apparatus ceases to have any of the properties of the pendulum, and is in fact simply an inert mass mounted on axes, and in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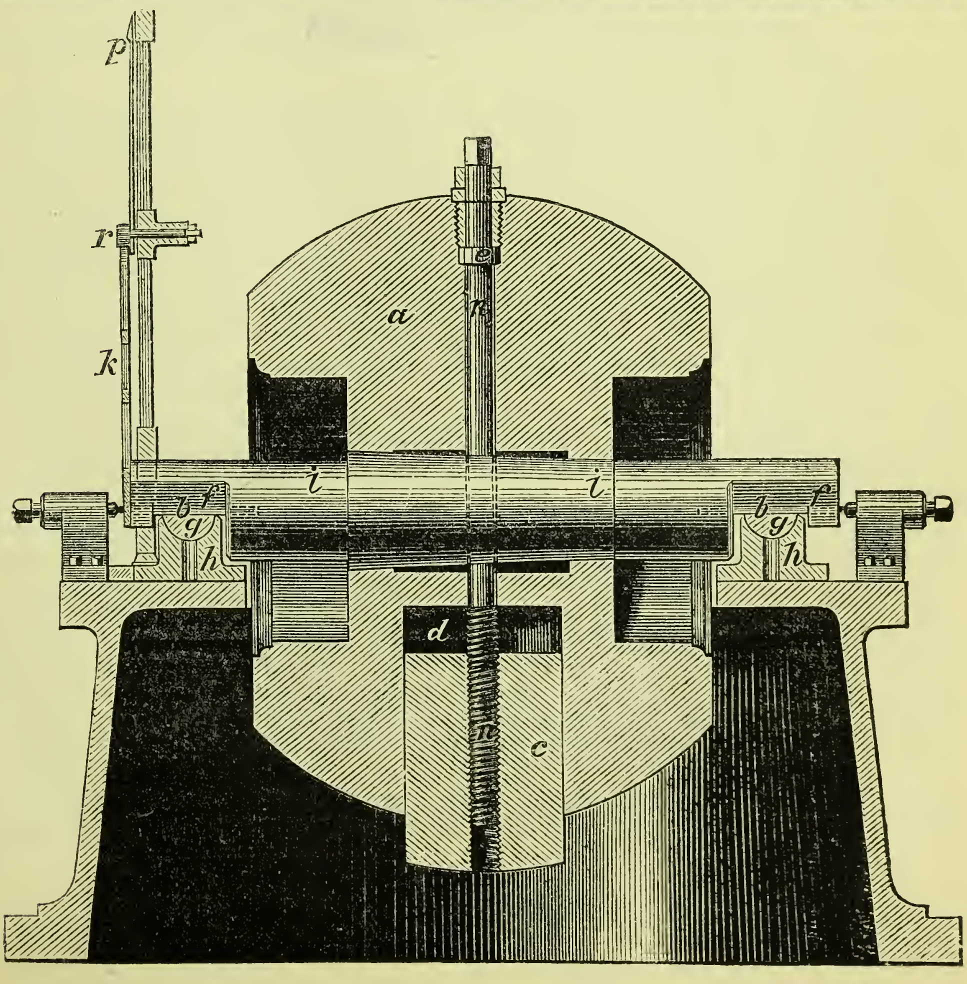
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a state of perfect equilibrium, and hence has no tendency whatever to acquire an oscillating motion by the mere translation of its axis, and will therefore under such motions of the vessel remain in a state of perfect rest as far as axial motion is concerned, provided that the friction of the axis is so small as to prevent the bearings, *g* (on which it rests), forcing it round with them. It was with a view to prevent all tendency of the mass, *a*, becoming gradually altered in position by this axial friction, that the weight, *c*, is employed, and which, by means of the screw, *n*, can be lowered to the exact distance required. That portion of the weight so lowered beneath the mass, will become so much pendulous matter, tending to keep the position of the mass with this pendulous matter vertically beneath it, while its action is nevertheless so small, that the translatory motion of the vessel cannot produce an oscillation of the inert mass, *a*, by reason of the small amount of pendulous matter forming part of it: hence we have an instrument capable of maintaining itself in a state free from any oscillation on its own axis, and capable of registering the motions of surrounding objects.

In order to allow of the movement of the supporting bearings, *g*, round about the axes, *b*, I have cut away three fourths of the main axis, *i*, leaving only a quadrant of the axis, as shown at *f*, and this remaining part serves to support the wire axis, *b*, which is only $\frac{1}{10}$th of an inch in diameter, and rests on the supports or bearings, *g*, the underside of which are fitted to hemispherical cups, *h*. Small grooves in the upper side of the bearings, *g*, retain the wire axes in place; the hemispherical form of the bearings allows them to adjust themselves to, and form an even support for the whole rubbing surface of the long slender wire axes, the rubbing surface of which traverses only over $\frac{1}{108}$th of an inch for each degree that the vessel rolls, and this distance on an axis so small as $\frac{1}{10}$th of an inch in diameter is incapable of transmitting motion to the mass, *a*, which weighs 300 lbs.

In order to register the number of degrees through which the ship rolls on a scale with coarse divisions easily read off, I fix to the main axle, *i*, of the apparatus, a toothed segment, *k*, in gear with a small pinion, *r*, the axis of which carries a pointer, *p*, so that a considerable arc is described by the pointer whenever the floor on which the apparatus stands is moved only slightly from the horizontal position.

With regard to the question of Captain Goodenough, in reference to the inverted pendulum employed in the apparatus for discharging guns at sea, I may observe that the term pendulum applied to such an instrument tends to convey a perfectly erroneous impression of its action, it is, in fact, not a pendulum, but simply what engineers call a "tumbling-bob," a mere weight supported on the top of a light bar, the lower end of which is brought to a sharp edge, which rests in a groove and is supported at its upper end between fixed brackets, against one of which it rests in an inclined position, until by the rolling of the vessel, it arrives at a point where the centre of gravity of the weight passes the vertical line, when it tumbles over against the opposite support, wholly free from those oscillations which accompany the swing of a pendulum, whenever its point of suspension is removed from a position vertically over the pendulous mass.

During the time occupied in the falling over of the weight, the ship's motion will continue to alter the elevation of the gun, and after the weight has fallen over and established an electric communication, there will still be an interval of time occupied by the traverse of the projectile along the chase of the gun, during which period the motion of the ship will continue to alter the elevation of the gun, and I compensate for both these sources of error by a special and permanent adjustment of the instrument, which may be most correctly effected by firing a shot through a screen placed a few yards from the gun, and so adjusting the quadrant of the instrument, that, when thus hitting a line marked on the screen in the same horizontal plane as the chase of the gun, the zero of the instrument is to be permanently altered, so that its zero point no longer indicates the period at which the weight becomes vertical and begins to fall over, but the instrument indicates the actual angle of elevation acquired by the chase of the gun at the moment the projectile escapes from its muzzle.

Captain Goodenough: Sir Spencer Robinson has said, in words much better chosen than I could possibly choose them, how much we are indebted to Mr. Bessemer

and to other men of science, who come forward like him to assist us in our endeavours, and I say further how gratifying a thing it is that in this country there is so much sympathy with nautical enterprize, and with the objects of the naval profession, that even people who suffer (as Mr. Bessemer does) on the sea, enter as warmly into these matters, as those whose profession it is to follow the sea. That is a subject of congratulation and pride to every Englishman. I may mention one thing in my own experience in confirmation of what Sir Spencer Robinson says about the superiority of mechanical means, even such as those we now possess on board ship, to that very imperfect instrument, a man's eye. We have recently fitted our ships with instruments by which we may fire the whole of our broadside by electricity. In the "Minotaur," with a broadside of 11 guns, we have frequently fired, first, broadsides by eye, and afterwards broadsides by electricity, with a mechanical arrangement. In the broadsides fired by eye, the captain of each gun stands at the end of his trigger-line; the guns are laid as near as they can be to the object, and the captains of the guns are directed to fire by a directing gun. The captain of this gun fires when the object is on with the point of his sight. With the other means—by electricity—the guns are all laid exactly by converging marks on the deck to the object, not by eye, but by mechanical means, to the same elevation, and they are then fired by communication from an observer at an instrument on the upper deck. We invariably found the broadsides fired by mechanical means were more accurate than those fired by the eye by the eleven men looking along the eleven sights of their guns.

Captain Burgess: I should like to ask Mr. Bessemer to explain whether his instrument will answer with the pitching of a ship. That instrument is arranged for lateral rolling, but will it act also in the case of pitching?

Mr. Bessemer: In fact it comes precisely to the same thing. If you were to place the instrument parallel with the line of the gun, whether the gun is projected from her bow, or the side, or any angle between those, which angles you get by training sometimes, it comes to precisely the same thing. When the chase of the gun assumes the position indicated on the instrument, at that time it is bound to fire, and at no other. It is quite irrespective of the direction or the position the gun occupies on board the vessel. Whenever the gun arrives at the determined angle of elevation, the firing will take place.

The Chairman: I shall premise the few remarks I shall make, by referring to a very important point to which Captain Goodenough has drawn attention; it is this. Mr. Froude explained to us on Monday evening very clearly his theory (which he illustrated by experiment) of the action of a pendulum when a vessel is rolling on the slope of a wave. He stated that instead of the pendulum hanging in a vertical position when at rest, it would take up a position normal to the wave slope. I had the advantage after the lecture on that evening, of hearing further explanation from Mr. Froude on that point. It is a question that would affect the subject now before us most seriously. If Mr. Bessemer's inverted pendulum were used, no difficulty would arise, but if a sphere or any other pendulum were necessary, Mr. Froude's theory would, if practically correct, introduce a new element to consider. Mr. Froude said, however, that the pendulum would take up the position he had pointed out only when it was infinitely short. This is most important, as no practical difficulty will arise when considering the best mode of adapting a pendulum to fire heavy guns at a given inclination to the horizon.

I most fully concur with the remarks that fell from Sir Spencer Robinson respecting the great importance of improving the accuracy of our fire at sea, when the guns are so reduced in number, and guns and projectiles are so increased in size. We must all feel that although our ships have also improved in offensive and defensive power, we have not advanced in any way in the accuracy of our fire. The guns, being rifled, are as accurate as we can wish them to be, far more accurate than anything we ordinarily require at sea, but we are still liable to the same sources of error as formerly, when we had 120 guns in a ship of the line instead of four. Any step taken to eliminate even one source of error, is a most important point gained. I consider that Mr. Bessemer has shown us the way to do that. He has taken a step in the right direction by showing us how to take advantage of mechanical means instead of trusting entirely to a man's eye and nerve. It seems to me, however, that the

inverted pendulum exhibited here this evening is not an instrument that could be practically relied on; the sudden motion of a ship, such as that caused by a ship being struck by a wave on the broadside, would very likely make a contact at the wrong time. But it is evident that the system of the sphere or some other description of pendulum might be introduced with the same object. I do not know whether Mr. Bessemer has contemplated that. (Mr. Bessemer: I mentioned it in the paper.) That is so clear that I think it is scarcely worth referring to. I am sure this is a matter well worth putting to the test of experiment, and that all naval men will be most thankful to see such an experiment carried out. I consider it is opening the door to an improvement in the accuracy of our fire in a seaway.

It would be uncourteous in me, especially as I see several members of the Naval College at Greenwich here this evening, if I did not refer to the remarks made by Sir Spencer Robinson when expressing his opinion as to the advantages likely to accrue from the Naval College lately established at Greenwich over which I have the honour to preside. I trust that they will prove to be all that the well-wishers of our service desire that they should be, and I can confidently say that there is no one in the service whose good opinion we should value on that point so highly as that of Sir Spencer Robinson's. With your permission I beg to offer Mr. Bessemer our cordial thanks on the part of the naval service for the trouble he has taken in investigating this difficult question, and for introducing what I believe is a step towards the improvement of the accuracy of our fire at sea.

Mr. Bessemer: I can but express myself exceedingly gratified at the very kind way in which the shortcomings of my paper have been kindly passed over by you, and the very complimentary way in which you have been pleased to speak of the system which I have endeavoured to illustrate this evening. I can only say in reference to it, that, if the Government would place at my disposal for the purpose, a gun and the use of a ship for a day or two, whenever it suits them best, I would very gladly at my own cost and trouble, fit up what I believe to be a proper instrument and connect it to the gun, and will make it all ready for firing, so that there will be no difficulty about the matter. It is one of those subjects which I have taken a very deep and lively interest in, and having so far brought it forward, I should not like it to stop at the stage it has now arrived at. It is the practical utility of all these things that we must look to in the end. I know the hands of the Government are tied and trammelled very much in our country in doing things of this kind, perhaps more so than they ought to be, but as far as any assistance of mine can go, it is most completely at their disposal. My only object is to see the invention made a success, because I believe it would be an immense benefit to the country if carried into practical operation.

LECTURE.

Monday, December 15th, 1873.

Field Marshal H.R.H. the DUKE of CAMBRIDGE, K.G., &c., President of the Institution, in the Chair.

EXPERIENCE IN SAVAGE WARFARE.

By Sir Samuel White Baker, Pacha, M.A., F.R.S., F.R.G.S., Major-General of the Ottoman Empire.

Your Royal Highness and Gentlemen,—I feel it is somewhat presumptuous in me to offer any remarks upon military matters, not having had the professional education of a military man; but at the same time, I hope you will understand that I never sought this honour, it has been pressed upon me, and therefore I appear before you as a matter of duty.

To those who have studied the military art as a profession, it may appear a light matter to engage in war against savages armed with the rude weapons of barbarians, and furnished with fire-arms of the worst construction. The Officer who has been educated according to the rules that guide the movements of European troops, might regard with contempt an enemy wholly without education, whose forces, although numerous, are apparently devoid of organisation, and resemble at the first glance, the uncertain surging of a mob. Now, in my opinion, there cannot be a greater error in any commander than contempt of his enemy—savage though he may be. It is true that in an open country a handful of disciplined troops is superior to a host of badly-armed savages; but it must be remembered that the natives of a barbarous country possess advantages which in some measure compensate them for their inferiority of weapons, and the lack of what we call "military education."

The African savage possesses a thorough knowledge of his country. From his childhood he has run naked among the tangled forests and gigantic grasses, through which he can move with the ease and almost with the swiftness of a wild beast. Like the animals of his forest, he seeks covert at the first approach of danger, and the jungle, which to troops in uniform is almost impenetrable, is to the native warrior a retreat that shields him from all danger. Thus when the African is opposed to disciplined forces, he invariably relies upon the security afforded him by the difficulties of his country. His tactics

of attack and sudden retreat to his thick coverts, are exceedingly annoying to regular troops, who cannot overtake so active an enemy. There is seldom a chance of forcing him to fight upon a fair open field; thus the natives' actual loss in action is generally light, and he is accordingly ready to renew his sudden attack upon the first opportunity. Although not soldiers in our acceptation of the term, it must be remembered that every individual is a warrior. From earliest childhood, he has been in constant practice with the lance and bow. His barbed arrows, frequently poisoned, do fatal service at a distance of 120 yards. I have measured these distances, and practised the men at marks. The lance is thrown with great force and precision up to forty yards, and will fall into a body of men at sixty yards. Thus they can throw them into a stockade or fort at night. The common musket becomes formidable when loaded with slugs and used from ambuscades; and although all these savage weapons appear ridiculous when compared with modern inventions, it will be found that in the close and cautious fighting of the bush and grass jungles, these naked savages are not to be too carelessly estimated. It may be considered, as a rule, that native warfare is conducted upon the principle of "surprise," always allied with treachery. They will employ false guides or interpreters, who, having gained the confidence of their European enemy, will lead the troops into an ambuscade. Ever watchful, the natives spy out the movements of troops from the tops of trees in which their dark bodies are invisible in the thick foliage. Should a lack of discipline permit, stragglers will assuredly be cut off, or sentries be stolen upon, and killed by a lance or arrow in the back. The favourite method of attack in large force, is during the night, when the darkness reduces the danger from the fire of rifles. On such occasions, the natives generally halt, according to the conditions of the country, in forest or grass, about half a mile from the camp they propose to attack. Scouts are sent forward to ascertain the position of sentries, before the advance of the main body. The scouts being quite naked, crawl upon hands and knees until the darkness has permitted them to approach within a few yards of the sentries. They then lie flat upon their bellies, unobserved, until they can retreat to the expectant main body in the rear. According to circumstances, the attacking force now advances in perfect silence, and, approaching upon their hands and knees in the same manner as the scouts, they suddenly spring upon the sentries, and with wild yells, make a general rush upon the camp. This sudden attack would be extremely dangerous unless provided against; and in this manner they frequently surprise and massacre every one of a large party of slave hunters, and destroy their camp.

An Officer in command of European troops engaged in "savage warfare" should always beware of two great dangers, "treachery" and "surprise." The greatest care is necessary in patrolling, and the strictest discipline must be observed among the sentries. Upon no account whatever should natives (even if friendly) be permitted to enter your camp with arms in their hands. The weapons should be left always outside the camp in charge of a sentry before a native is

allowed entrance. A favourite mode of attack is thus treacherously to enter the camp armed, until by degrees a sufficient force has congregated, when at a given signal they rush upon the unsuspecting troops. I have known a whole party of slave traders killed in this way.

From this short description of the habits of Africans, it will be easily understood that bush-fighting must at all times be most unsatisfactory to regular troops. They will be harassed by fatiguing marches in a bad climate. Night attacks will constantly disturb their rest; men will be killed and wounded by unseen enemies in ambush, and there will not be the satisfaction of a fair stand-up fight in the open, to prove the superiority of the troops. From the experience of some years, I find that the best plan for carrying on a native war is to combine native tactics with the general manœuvres of regulars. The natives never expect that you will attack them on their own principles. Thus, ambuscades may be met with ambuscades, their positions may be carried before daybreak by a silent night march, and a sudden rush; and arrangements may be made for secretly occupying a large area by detached parties of riflemen in line so concealed in grass or bush, that the wily natives must inevitably fall into the snare when endeavouring either to reconnoitre or to attack the position.

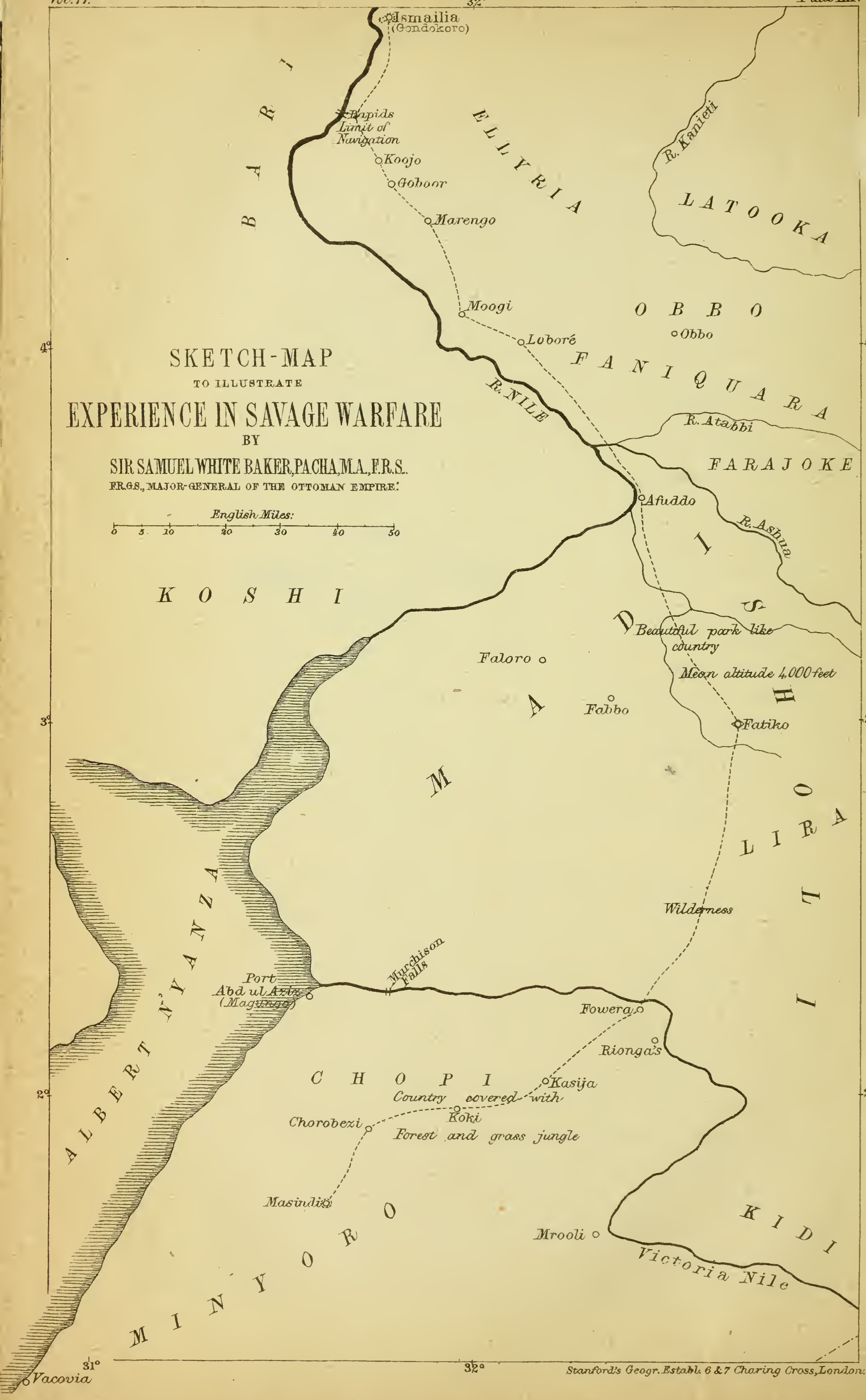
In commencing an African war, the first consideration is the outfit and the arms best adapted for bush-fighting.

With few exceptions, long range rifles will have little practice, as the enemy will seldom show in the open. I should arm only one company in each regiment with rifles; the remaining companies should carry single barrelled breech-loader smooth bores of No. 10 calibre. The cartridge should be long enough to contain a charge of six drachms of powder with one No. 16 spherical bullet and twenty-four mould shot of the size known as S.S.G. A short sword-bayonet or broad bladed knife twelve inches in length of blade, should fix on this gun as upon the Government rifles. Now this knife should be strong and sharp, but without the cross guard, which is an unnecessary weight in the use of sword-bayonets. Such knives would be invaluable in camping out when it is necessary to clear away grass from a camp, or for cutting poles for huts, &c. Guns of the description I have named, would be far preferable to rifles for fighting in bush or grass jungles. The No. 16 bullet would travel through a long range, while the mould shot would be effective at 150 yards, and would sweep the enemy out of the covert with very fatal effect. It must be recollected that one volley from a company will throw about 2,200 shot and ball; this would be irresistible when delivered into masses of men. Should the regiment break covert and advance upon open ground, the rifle company would be thrown forward as skirmishers. When in jungle, the rifles would simply protect the rear. Rockets are invaluable, especially those known as Hale's three-pounders. These in reality weigh five pounds. In bush-fighting, the object of the rocket would be to try the jungle before the troops advanced. A forest or a prairie of high grass may conceal a large force of the enemy that would rush upon the troops when passing in single file along a narrow footpath, or attack them on flank and rear. A few rockets fired into the bush at a rather low

angle, so as to ricochet, while two or three were fired at a long range so as to explode beyond the enemy, would assuredly discover them, if concealed. A common native practice is to surround the troops with fire when marching in the high dry grass in the summer season. This is exceedingly dangerous should the wind be high, at which time the flames will travel at about six miles an hour. This I have also proved, because in American accounts of firing the prairie, there is no greater exaggeration than what is stated as to the speed at which the fire travels. We have seen pictures of cattle and horses galloping at full speed, and yet the fire overtaking them. It is perfect nonsense. I have walked before the fire in a high wind, and have also run before the fire in a fresh gale of wind, but I have never seen it travelling at a greater speed than six miles an hour. Therefore, if troops should be surrounded by fire, and do not lose their presence of mind, which men most likely will under such circumstances, there is plenty of time allowed for cutting down a little of the prairie grass in front, and setting fire to it in advance. If the grass is high enough to burn, on no pretext should troops enter it until cleared by the rockets, or set fire to by your own men. Upon such an occasion, should the enemy be concealed in the prairie, the grass may be set on fire far to windward by the rockets, and they would be placed in a difficult position. That dry grass question is a most serious one. I do not know whether in Ashantee country, the grass has the same character as the prairie in the centre of Africa, but if so, that must be recollected by whoever happens to be in command there, because a short time before I arrived at Fatiko, there had been a loss of every one of a slave trader's party. The natives set fire to the grass in one portion to attract the attention of the men. They were in ambush themselves, and out of 103 men composing the slave hunting party, not one man escaped. At the same time that I acknowledge the extreme importance of Hale's rockets, I must express my astonishment and disappointment, that projectiles so admirably adapted by their portability for savage warfare, should be rendered almost useless by the absence of explosion. A rocket weighing five pounds (*i.e.*, the so-called three-pounder) can be slipped under the strap of a soldier's knapsack and carried with ease during a march, so that without extra transport, the projectile is at immediate hand. It is invaluable when the troops are making a night attack, for as they have to be under arms at midnight, and to march 12 or 16 miles by daylight, in such circumstances it is most cumbersome to employ native carriers, and also very uncertain, because they are extremely likely to bolt. This rocket should explode with a bursting charge of an ounce of strong powder. Upon bursting, it should scatter inextinguishable fire-balls that would burn for a minute. This arrangement would produce the *ne plus ultra* of projectiles for bush-fighting. Two or three rockets would suffice to shell out a stockade, as the thatched houses would be immediately ignited, and the heat would compel the enemy to evacuate the position. I used Hale's rockets throughout the Bari war, but in no instance did they ignite the thatched huts. Upon several occasions they passed through the grass roofs, but the rapidity of their flight did not afford sufficient time for ignition, as the rocket can only depend upon its

back fire. This is an important defect that can easily be remedied by the application of the explosive system proposed. Field guns will be of little service in the bush, owing to the great difficulty of transport. Explosive rockets would be much more serviceable. The only use for the guns will be for the defence of stations, where they would be used with case shot. I had ten guns in my late expedition,—rifled bronze barrels weighing 230 lbs. each, to carry shell of $8\frac{1}{4}$ lbs. Having no means of transport, I found them simply a useless incumbrance in marching, and they were quickly condemned to inaction in the fort. The result of my experience would lead me to condemn as useless for the actual bush-march, any other weapons except explosive rockets, powerful breech-loading smooth-bores for buckshot, and rifles for open country. There should be another important addition to the outfit of the troops. Every man should carry on the top of his knapsack, under the straps, a small but strong axe. This should be of a rather soft steel, so that it can be easily sharpened on a stone or with a file. Hard-tempered steel will chip, and the axe will soon be rendered useless by the hard woods of tropical countries. The success of an expedition depends in a great measure on the health of the troops. Nothing is so conducive to this as the possession of a handy little axe by each man. When the halt is sounded, the first order should be "build huts for the night." In the rainy season, or should the weather be doubtful, it will always be advisable to finish the day's journey in one march. Thus, from 6 A.M. to 11, the men will march 14 miles, which is quite sufficient for them if they have to march every day. In an enemy's country not only have the men to build huts, but it will be necessary to protect the camp by a strong fence of thorns, so that it cannot be stormed by a sudden rush during the night. The axes at once come into play. The sword-bayonets, kept well sharpened, are most useful in clearing the high grass from the neighbourhood. This serves a double purpose,—roofs for the huts and bedding for the men, while the ground is cleared for the sentries.

My men were for the most part blacks; thus they could endure fatigue and exposure that would have been trying to Europeans. Their kit consisted of a scarlet flannel shirt, white Zouave cotton trousers, gaiters, and sandals. They carried a spare suit in their knapsacks, together with a blanket, but no great coat. No tents were carried on the march except one for myself, which I abandoned for want of transport, and contented myself with a few waterproof camp sheets. We thus travelled in light marching order, which I strongly recommend if fighting is contemplated in the bush. No one can conceive the advantage of being free from the trouble and delay of packing heavy baggage when starting before daybreak. In every bush-country, silence must be rigidly enforced during the march in time of war. A multiplicity of baggage is sure to occasion chattering and noise among the carriers, which may give the alarm to the enemy when a secret march is essential to success. Secrecy and rapidity of movement are the first elements of bush warfare. In these qualities the African natives excel. It is therefore necessary to employ spies, and to keep in pay, if possible, some of those discontented spirits


SKETCH-MAP
TO ILLUSTRATE
EXPERIENCE IN SAVAGE WARFARE
BY
SIR SAMUEL WHITE BAKER, PACHA, M.A., F.R.S.
F.R.G.S., MAJOR-GENERAL OF THE OTTOMAN EMPIRE.
English Miles:
0 5 10 20 30 40 50
32°
4°
3°
2°
31°
Ismailia
(Gondokoro)
Rapids
Limit of Navigation
Koojo
Goboor
Marengo
Moogi
Loboré
Obbo
Afuddo
Faloro
Fabbo
Fatiko
BARI
ELLYRIA
LATOOKA
OBBO
FANIQUARA
FARAJOKE
KOSHI
MADI
LIRA
ILOTI
CHOPI
MINYORO
KIDI
R. Kanieti
R. NILE
R. Atabbi
R. Ashua
Beautiful park like country
Mean altitude 4,000 feet
Wilderness
Murchison Falls
Port Abd ul Aziz
(Magungo)
Fowera
Rionga's
Kasija
Country covered with
Koki
Forest and grass jungle
Chorobezi
Masindi
Mrooli
Victoria Nile
ALBERT N'YANZA
Vacovia
Stanford's Geogr. Establ. 6 & 7 Charing Cross, London.

that are to be found in all countries, who, having quarrelled with their own people, are eager to turn against them. These men must keep the commanding Officer (and him only) informed of the intentions and movements of the enemy. It is essential in all countries in bush-fighting to make certain that you can get spies that you can depend upon, because these people are so treacherous and so exceedingly clever that they will engage as spies but simply to spy *you*, and of course they lead you into all sorts of difficulties.

When the Khedive's expedition first reached Gondokoro, N. lat. 4° 54′, the military force consisted of 1,200 men. The troops were occupied in building the station and in erecting iron magazines for the innumerable stores, &c., at the time when the Bari war broke out. This powerful tribe, having been incited by the slave-hunters to resist the Government, commenced war. The country resembled a well-timbered park bordered by the river Nile, and diversified by mountains about eight miles distant. The forests in the neighbourhood were particularly beautiful. There was one forest in which you could ride for about an hour, composed almost exclusively of magnificent tamarind trees; in fact, nothing can exceed the beauty of the whole country.

The Baris are a very active and warlike people, numbering, I should imagine, about a million and a half. Although these people had lately been at war with a powerful tribe about three days' march east of Gondokoro, they concluded not only peace, but an alliance with their late enemies, for the express purpose of making a joint attack upon the Government station. At that time the troops were so engaged in erecting shelter for themselves and for the stores, that no regular defence had been commenced. The only protection for the station, was a fence of thorns, simply boughs laid upon the ground, one upon the other with the stems inwards. I had a separate station a mile and a half distant upon the bank of the river occupied by the corps of 48 Snider rifles, which formed my body guard. These men were selected from the two regiments which formed my force, and I had taken much pains in teaching them the use of the rifles. This little *corps d'élite* was a great exception, both in discipline and intelligence, to the main body of the expedition, and I owe not only my success, but the actual existence of our party, to their superior arms and organization. I take this opportunity of saying, I think that even among savages, although at first you may be disappointed by their obtuseness, and in fact by the extremely low level of their intelligence, after a little time, you may improve their *morale* by setting them a high example, and by establishing in fact a sort of code of honour, which though at first they do not understand, yet an *esprit de corps* will be the favourable result. I picked out these men from the 1,200, and if a man showed some inferiority he was drafted out again and another man substituted. If a man was a thief, I used to call the men together, and not only did I punish him, but I gave them a lecture upon the disgrace of thieving in the character of a soldier. At last I established such a praiseworthy *esprit de corps* among them, that they would have gone through fire and water for me; and if by vacancy or death, it was neces-

sary to replace a man, if the character of the man selected was not wholly known as honest, the others would not accept him; they would say, "He won't do for us, he will only do for the regiment; you cannot depend upon him, he is light-fingered," and so on. This was a most satisfactory result.

My station at that time was merely a very pretty garden by the side of the river. I had hardly commenced a fort; but I had a few huts with my "forty thieves," as I used to call my *corps d'élite* in the neighbourhood. No open hostilities had commenced, and I had no idea of an intended attack. At about two in the morning, I was awakened by the sound of shots fired at head quarters $1\frac{1}{2}$ miles distant. This was followed by the yells of an untold body of natives, who had simultaneously attacked the camp. The bugles sounded the alarm, and in a short time a heavy file firing told that the attack was general. My few men fell into position, but I could, of course, do no more than hold my station, momentarily expecting an attack upon our weak party. It was a strange thing that the natives had devoted themselves to the attack of the chief station garrisoned by upwards of 1,100 men, instead of attempting an assault upon my little post, but I suppose they were expecting to get hold of the ammunition. In about half an hour the affair was over, and the enemy was repulsed with the loss to us of one corporal killed and some soldiers wounded by arrows. In this attack the native scouts had been challenged and fired at by the sentries. They had then used peculiar tactics. At a distance of about half a mile they rang bells, beat their drums, and blew their large horns so as to deceive the troops, with the idea that they were at a great distance from the station; but in reality their main body was stealthily advancing in the darkness, while the drums and horns were sounding in the distance, until they suddenly rushed unexpectedly upon the station. The protection of thorns served to check the assault until the heavy fire of the garrison repulsed them. This attack was the signal for general hostilities throughout the country, and I established patrols by day and night, in addition to the usual sentries. In spite of this, we were subject to continual disturbance; every night the sentries fired upon scouts who were discovered approaching in the stealthy manner already described. I set all hands to work to entrench the camp, and at the same time made a triangular fort at my private station. The ditches and earthworks were completed in about three weeks, and guns placed upon the bastions. During this time, we had been as usual annoyed by the natives, more or less, every night, until I arranged a plan which put a stop to their attempts. The plan was simple and very effective. I posted small parties, consisting of five men each, in convenient positions, such as behind the massive hillocks raised by the white ants, or behind a thick solitary bush. These parties were thoroughly concealed at a distance outside the usual beat of the patrol, and every approach to the station was thus guarded. I felt sure that the enemy would fall into the trap, as they would as usual attempt to reconnoitre, but would have no suspicion of such ambuscades outside the patrol. For this night-work I changed the arms, and for the Snider rifle, so invaluable by day, I substituted muskets, with each a

cartridge of eight buck shot, rammed down above the ball. Nothing could be more successful. As I had expected, the natives came unawares upon the guards thus concealed. Every night the positions were changed, and thus it was impossible for the enemy to know the points of danger. Several of them were shot; one was captured alive and hung on the following morning on a tree as a warning to the rest, and in a short time the nights were so entirely undisturbed that not one native dared visit the camp. The forts were finished, the magazines were erected, and the entire material of the expedition was under shelter. There was no possibility of an attack upon so strongly fortified a position. I accordingly started with a force of 450 men to punish the Baris who had imagined that we were afraid to enter the interior. The first point of attack was the country of Belinian, about twelve miles distant. These people had been the worst among our enemies. They had murdered several sentries. In fact, sometimes the Baris appear to have quite as much cunning and audacity as North American Indians in stealing upon the sentries and murdering them before they had the least idea of their neighbourhood. The country was exceedingly beautiful, being a mixture of forests, mountains, and plains; the latter being cultivated to a large extent with dhurra (*Sorghum vulgare*), which grew to the height of about 9 feet. There were five or six hundred villages throughout this populous country. The natives had formerly succeeded in destroying some slave-hunting parties; thus they were possessed of more than a hundred guns and a considerable stock of ammunition. The Sniders very quickly produced an impression. The natives opened fire from their stockades, which were taken and forced at the bayonet by my troops with the loss of only one man and one woman wounded by bullets. It appears extraordinary that the women should come into action, but the fact is, that they followed close up to the troops with provisions.

After a few days of sharp experience, the natives took to their mountains and forests, in which they concealed their cattle. I determined thoroughly to explore the bush, which, although dense in some places, would usually allow an advance in skirmishing order. I venture to suggest that an advance through the bush should be conducted by three lines of skirmishers, each distant about twenty yards, while the skirmishers forming the first line should be only a man's length apart. An advance in this open formation with three companies, will cover about 200 yards in length. The rear rank forms a protection, while the second line will act as support, either for the first line, or, should the rear be attacked, they can face about and support it in turn. I succeeded effectually in driving the enemy from their forest hiding-places, and in capturing both corn and cattle. This was accomplished with the loss of very few men on our side. I do not think more than five or six were killed; this included the murder of a Turkish Major who had been through the Crimean War, but lost his life by losing his road through a breach of discipline, and fell into the hands of the enemy, who show no mercy. Upon my return to head-quarters after thirty-two days, I found it necessary to commence operations on the west bank of

the river. This was beautiful open ground, and afforded an opportunity of trying the Arab horses, twenty-one of which I had brought with me from Cairo. Wherever the *country will admit* of cavalry operations, this arm should be employed against savages. In the portions of Africa that I have visited, the natives have an extraordinary fear of horses, which to them are strange, and supposed to be dangerous animals. I have frequently charged with only four or five horsemen, captured herds of cattle, and put to flight large numbers of the enemy, whom I have held in check until the arrival of the infantry. Unfortunately, I lost nearly all my horses by an epidemic, and at the close of the expedition only three remained. Such losses should not deter either a Government or a traveller from employing horses. They are invaluable, and when used up, they will have more than earned their cost and the expenses of their transport.

The Bari campaign that had been carried through on the east of the Nile had so far raised the prestige of the Snider company, that their appearance on the west was sufficient to over-awe the country which was almost devoid of forest, and accordingly no covert existed for the enemy. For an immense distance, the landscape afforded a perfect field for military operations. The grass having been fed close by innumerable cattle, exhibited a clean surface upon long rolling undulations that drained from the distant mountain chain to the Nile. Each ravine between the waves of high ground was, in the wet season, a roaring torrent, but was, in the dry season merely a deep bed choked with rocks. The whole of this country was thickly populated. I advanced south in eight vessels, the troops marching on the banks of the river. I had only 250 men, as the Egyptian regiment had returned to Khartoum, some sick, but all dissatisfied on account of my suppression of the slave trade. The black troops were well adapted for the rough and constant work required. Many of the Officers and men had served under Bazaine for some years in Mexico, and they, and in fact all, were far superior in *esprit* to the Egyptian Arab regiment. The Snider company had hitherto been distinguished by scarlet flannel shirts, and so great was their reputation, that the sight of a red blouse was enough to create dismay among the natives. I now dressed all my men in scarlet and proceeded to the south, intending to push on towards the Equator to annex the country, and to purge the new territory from the slave-hunters, who numbered about 1,100 men in the southern districts. These were mostly Arabs of the Soudan, together with many black soldiers who had deserted from their regiments at Khartoum and settled as pirates in the employ of a firm (Agād and Co.). This firm employed about 2,500 such ruffians as slave-hunters in Central Africa. These men were organised as irregular troops armed with muskets, rifles, and double-barrelled guns, and were officered in imitation of the Government regiments. All were Mohammedans. The slave-hunters had endeavoured to incite the natives against the Government throughout all these countries. In some they were successful.

My vessels arrived at N. lat. 4° 38′. This is the limit of navigation on the White Nile at the foot of the last cataracts. It was impossible

to make friends with the natives, all of whom were Baris. A great chief pretended friendship, but his people attacked the guards at night and attempted to carry off the cattle. Fortunately, I had taken every precaution, and the enemy was repulsed. It was quite impossible to proceed, as I was without either carriers or transport animals. Having a good knowledge of the country, I left 150 men in charge of the vessels, and, with a hundred men, I started for the country of Loboré beyond the Bari frontier. There I proposed to hire carriers, who, with an escort of troops would return and bring up the baggage from the vessels, which would then return to Gondokoro. From that point (lat. 4° 38′) the entire expedition for the annexation of Central Africa and the suppression of the slave trade would be composed of only 212 picked troops, including Officers, buglers, drummers, &c. I was well aware that, should I fail, I should be blamed by all military authorities, as I had a march before me of about 350 miles without the power of forming posts of communication. Thus I should be cut off from my base. I knew also that the slave traders were against us, although at that time I did not expect open hostilities from them. By the departure of the Egyptian regiment, my entire force was reduced to 502 Officers and men. I had therefore to determine upon action with great risks, or inaction at headquarters. The latter would have played the game of the slave-hunters, and the expedition would have been a failure. I fully expected that after my departure with a hundred men for Loboré, the natives would attack the Officer and the weakened detachment in charge of the vessels and baggage. I therefore drew the vessels in close line along the bank from the mouth of a broad and deep but dry ravine, which ran at right angles with the river. The south flank was thus protected; the west was the broad Nile (about 400 yards in width). We were only exposed on two points—the east face and the north flank. I placed a six-pounder gun in position on the east face, which commanded every approach, as the country, though undulating, was perfectly clear. My instructions before leaving the Officer in command were as follows: at sunset, all cattle (about 2,000) to be secured in the bottom of the ravine close to the river. A sergeant's party to line each side of the ravine as cattle guards. These men would in case of an attack on the east face enfilade the enemy, who would be exposed to a cross-fire in addition to that of the gun. The gun to be loaded at sunset with a canister containing 250 musket balls. The tube to be placed in the vent with the lanyard attached. The gun to be sighted for 200 yards, and to be covered with a raw-hide to protect it from the heavy dew. I served out some new English tubes, as those supplied by the Egyptian Government were very uncertain. I left all vessels and men with the above precautions.

Many people may imagine from what I have done, that there could be no great difficulty with the natives; but unfortunately I have always found that whenever I have sent an Officer in command of troops with certain orders, they invariably met with calamity, if not defeat, through the carelessness of the Officer in command. I reached Loboré in four days, through a most populous country,

without firing a shot. I engaged 500 carriers which I sent to the vessels with an escort of 50 men. In the meantime a general attack in great force had been made upon the vessels. It was a rule without exception, that if I left an Officer with a certain duty to perform, it was neglected. The sentries were for the most part asleep. The gun was not even loaded. The good English tubes had been put away so carefully that they could not be found. The natives attacked in the dead of night. They surprised and drove in the guard upon the east face, who took refuge in the vessels. The artillerymen deserted the unloaded gun. One man was killed upon his piece in his vain attempt to load it. A woman was killed in a boat by a spear. Fire was thrown into the vessels. The six-pounder gun was actually in the hands of the enemy, but they did not know how to carry it off. This attack would have ended in the destruction of the party and the vessels and material had it not been for the flanking fire from the cattle guards posted along the edge of the ravine. This created confusion, and killed and wounded many of the attacking party. The soldiers in the vessels having recovered from their first surprise, poured a heavy fire into the front and took the gun. The artillerymen in their haste loaded the gun with shell instead of canister, and even then they could not fire it, as tube after tube failed, in the absence of the good Woolwich tubes. However, after all this disgraceful mismanagement, the enemy were repulsed. This little incident serves to show how much depends upon the Officer in command, even when regular troops are opposed to savages. There is no quarter given in such warfare. A victory gained by the savages implies the massacre of every one of their opponents.

My men arrived safely at Loboré, numbering 212, including Officers. The vessels returned to Gondokoro. We were now fairly started, and were out of the Bari country. Every native was a friend, as I was well known to them on my former visit. I arrived at Fatiko, N. lat. 3°01′, a distance by route of 161 miles from Gondokoro. No one can conceive a more beautiful country. The climate is comparatively cool. The mean altitude of the land is 4,000 feet above the sea level, and the landscape is a vast park laid out by nature with a combination of rocky hills, magnificent timber, fertile valleys, clear streams never more than a mile apart, rippling over the acacia shaded rocks, and distant mountains closing in the horizon. In this paradise the slave-hunters had established the most perfect hell. They not only occupied Fatiko by a large station, but they possessed a chain of four well-chosen positions, each about 22 miles apart, which, being garrisoned by about 1,100 men, dominated the entire country. Now these people whenever they attack a country, always do it by treachery. They are generally well received by the natives, who make them presents of cattle, and even of young girls, &c.; but after they have established thorough confidence, they will get up at midnight and make a treacherous attack upon the villages; they set fire to everything, murder all the old women—(because, being old, they are impossible to sell in that country)—likewise the small children, and in this way they utterly destroy a beautiful country.

I was well known to the natives of Fatiko in my former journey. The chiefs quickly assembled and claimed the protection of the Government, declared their allegiance, and recounted the horrors and reckless massacres committed by the slave-hunters throughout the country. I at once gave them protection; and as Governor-General of the country, I gave the slave-hunters written notice to leave the country and to return to Khartoum by a given time. At the same time I offered them the option of enlisting in the Government service to form an irregular corps. I left at Fatiko a detachment of 100 men with the heavy baggage, and the greater portion of the ammunition under the command of a major, and started with 112 men for the capital of Unyoro (Masindi), a distance of 160 miles south of Fatiko, within a long day's march of the east bank of the Albert Nyanza. It is impossible to see the Albert Nyanza from that position, but with a telescope you can see the waterfalls pouring down from the mountains on the lake, therefore I concluded the west shore was about 50 miles distant. In the short space of a lecture on "Experience in Savage Warfare," I cannot venture into the details of the intrigues and difficulties which terminated in a rupture with the King of Unyoro. I had hoisted the Ottoman flag, and formally annexed the country, with the understanding that the King was to represent the Government. We were apparently the best friends, and he begged me to send to Fatiko to recall the Officer in command together with all troops and material, so as to concentrate my force at his capital, Masindi (N. lat. 1° 45'). With the treachery usual among his race, he had laid a deep plan to massacre the whole party, and to possess himself of the arms and ammunition, together with all the effects of the expedition. I wished to concentrate my force at Masindi, believing in the good faith of the King and his people. I therefore sent a sergeant and ten men with letters, together with twenty-five men who had enlisted as irregulars, thus forming an armed party of thirty-six men, accompanied by three hundred natives as carriers, who were to convey the effects from Fatiko, in charge of Major Abdullah and his detachment of 100 men. He was an Officer whom I trusted, as he had been in Mexico under Bazaine for some years. In reality it was intended that the 300 natives were to carry the effects and to gain the confidence of the troops; but when near Unyoro, the unsuspecting soldiers were to be murdered while asleep. In the meantime, I and my little force of 100 men were to be poisoned and got rid of as speedily as possible. My men left with the post for Fatiko on 23rd May, 1872.

Although the natives of Unyoro are inferior to the Baris as warriors, they are far more dangerous, as that extensive country is thoroughly organized. The King has a large body of troops continually about him, including a body guard of about fifty men armed with muskets. Every district is under the government of a Chief, who is personally responsible for the acts of his people, all of whom must rush to arms upon the beating of his war-drum. Thus, in case of war, every Chief of a district arrives at the head-quarters with an army, an army called suddenly by the war-drum, and it is most extraordinary to see the celerity with which these people collect. Thus it would be

impossible to guess even the approximate number of warriors that could be raised in Unyoro at the King's command. The extent of Unyoro is about 160 geographical miles in length and 70 in width. Some natives are armed with bows and poisoned arrows, some with spears, and a few with guns.

After the departure of my men for Fatiko a change in the manner of the King and some of his principal Chiefs determined me to build a small fort for the protection of my ammunition, &c., in case of need. My men worked with great alacrity, and as the timber was close at hand I completed in a few days a circular stockade of thick trunks of trees buried 2½ feet in the ground. It was my intention to surround this with a deep ditch, the earth of which, thrown against the stockade, would have rendered the crevices ball-proof. I believe the erection of this little fort hastened the attack, as the guilty King suspected that I had gained information of his treachery. There were about 8,000 armed men in Masindi, but few women. The absence of women is a sign of distrust and suspicion in savage countries. If you go to any country and the women and children come to see you, or are seen running about without any suspicion, there is no fear of hostility; but if you do not see the women, you may depend upon the necessity for keeping a strict guard. The capital town, Masindi, consisted of several thousand houses, built, as is usual in that country, of canes and straw, resembling huge bee-hives. My station was adjoining the town, entered by a broad gravelled approach, like a carriage drive. On the evening of the 7th June, an attempt was made to poison myself and the troops. It had been the custom of the King on many occasions to present me with plantain cider in large quantities. On this occasion seven jars were brought, five of which were served out. The force of the poison was so immediate, that a warning was given to the men before all had time to drink, for about forty were in a state of delirium and insensibility. I administered strong emetics and shut up the sick within the fort. I turned out the remaining sixty men, who kept guard throughout the night. On the following morning, at 5 o'clock, I inspected the sick within the fort; they were much better, and I sent them to their quarters. I sent a Lieutenant and a corporal to beg the Sheik to come and examine the cider that remained in the jars. The Sheik's house was about 200 yards distant. I was walking up and down the approach smoking a pipe and expecting the return of my messengers. A bugler and a sergeant were behind me; thick castor-oil shrubs bordered either side of the approach. Suddenly I was startled by the savage yells of crowds in the direction taken by my messengers, and two rifle shots in quick succession were the reply. The bugler, by my order, sounded the alarm. At the same moment a hot fire opened upon me and upon the Government House from sharpshooters concealed in the castor-oil shrubs within a few feet of me. The sergeant at my side fell shot through the heart, another man quickly fell shot through the lungs, and another was shot through the leg. The fire being exceedingly hot, was replied to with very great alacrity by the troops. The men had had so much fighting for some years that they could be thoroughly depended upon,

and the moment they heard the bugle they formed a square, in very open order sufficient to protect a couple of acres of ground. It was done instantly; but had not the bugler been at hand, we should have been overwhelmed, for hardly had I my rifle in my hand and my belt fastened, when there was a rush of about 8,000 men upon the station. When that first rush was made, it was extraordinary to see how impossible it appeared for natives in masses to produce any effect against Snider rifles. They were cut down in the high grass in all directions.

One thing which is very necessary in African warfare or travelling, and I think in the Ashantee war we ought to have them, is a good supply of blue lights (capped blue lights), that you can immediately strike upon the butt end of your gun. Luckily for me I had plenty, and the first order I gave was for two parties to advance on each flank to set fire to the town to the right and left under the protection of the Sniders. A blue light will set fire to a grass hut in an instant, but a hut is a very difficult thing to set fire to with a fire-stick; you have to blow the fire with a bit of grass on the top, and meanwhile you may have a lance or a bullet through you. These two parties with blue lights set fire to the town to the right and left; a strong breeze luckily was blowing from us, and in a few minutes there was a roaring sheet of fire. This protected both our flanks; so I immediately gave an order to the sixteen Sniders to advance into the heart of the town, protected by the fire on the flanks accompanied by men with blue lights, who fired every house as they passed. There were not more than 100 of my men, and there were certainly 7,000 or 8,000 of the natives, about 50 armed with guns, and all organized to a certain extent by having a Chief to each regiment; but in the course of an hour and a half, not only was the enemy entirely defeated with great loss, but every single house was destroyed by fire, and the battle was won.

This was a very awkward position, which all military men will appreciate. I was 330 miles from head-quarters. I had already sent 300 carriers to Fatiko who I knew were traitors. Now the veil was lifted, and these 300 men would murder my 100 men that I had written for; therefore I should lose my little force with the whole of my ammunition, and in fact it would be utter destruction. Nobody knew the way—there was no road—the country was covered with forest and grass jungle; it was the middle of the rainy season, and in fact it was the most difficult time that I ever had experienced. I knew perfectly well what to do, but the great difficulty was, how to do it. I had a mass of luggage of all sorts without one man to carry it; I had a quantity of ammunition, but who was to move it? Every day's delay would raise additional thousands against us, and I knew that the King,—who had run away at the commencement of the fight,—would stop the road, and orders would be sent immediately, so that we should have to fight every inch of our way with only one hundred men, carrying loads through this infernal jungle. However, I made up my mind, and called my men together. Now these fellows who were so undisciplined at first, had really become so thoroughly disciplined by the example of the Snider corps, that it was only necessary for me to give an order—they placed such entire confidence in me after having

gone through so many difficulties with me and having got out of those difficulties with so little loss, that it was only necessary to give an order and they instantly obeyed it. I called the men together and spoke to them. I said, "we are in a dilemma, but you have often been in dilem-" mas with me, and we have always got out. Now is the time for you " to show whether you are men or not. It was only a day or two ago " in the battle of Masindi that you, one hundred, beat something like " eight thousand. Now you will have to fight every day. You will " have to march through grass that we came through some months " ago, now it is ten feet high, but then it was only up to your breast, " and you will have to fight every inch of the road. Every man will " carry a load; we must have merchandise to pay our way with " when we arrive at the river." You must have money of some sort in Africa. I arranged the march in this way. The advance guard was led by a most excellent Officer, Colonel Abd-el-Kadir, with sixteen Sniders; they carried no luggage, and he, of course, had a bugler. I came next, in charge of all the ammunition, with Lieutenant J. A. Baker, R.N., and Lady Baker close behind me and my servants, and ten Sniders and a bugler. The rear guard was commanded by a Captain with 16 Sniders, all admirable men, and the few Sniders that were left afterwards were interspersed along the line armed only with muskets. I made an arrangement with my men, "In case you are " attacked by an ambush on both sides of the line, every alternate man " is to face right and left," so that they could open a line of fire to right and left immediately. The men were a little nervous the first two days, and they had reason to be. We were attacked by enormous forces, and how it was that they did not overwhelm us I cannot tell, except that they were so thick together that the bullets must have taken frightful effect in the high grass. Moreover, there happened to be some double-barrelled breech-loading elephant rifles which carried eight drachms of powder and a picrate of potash shell, which would leave very little of a man if it exploded on him. It also made a hideous noise, the report of the shell being rather more than the report of a rifle. I always noticed in a hot attack when the lances were flying about in the most unpleasant manner, that whenever these picrate of potash shells were fired, some great effect was produced. We had to fight in this way, marching 14, 16 or 10 miles a day, sometimes through swamps, always through this fearful grass. We had to fight for seven days from morning to night, never seeing the enemy, but all through ambuscades. The difficulty was to convey the wounded. There were only two horses, which were loaded like camels with luggage. My wife had to march on foot during the whole of the work. There was only one donkey which was a spare animal, he was carrying a wounded man, and still I am happy to say I got through and never left one wounded man in the hands of the enemy. I am quite sure if it had not been for the discipline of those troops, no force of that small number could possibly have got through; but they observed a most admirable discipline from the commencement of the march to the end. Although it was impossible to see more than five men in front and an equal number behind, on account of the high grass, still of course we kept

up communication by bugles. If it had not been for the bugle in the rear which always sounded "halt" when a man was wounded or perhaps some woman was tired or had to shift a load, our line would have been cut, and if so, there would have been an end to everything. At all events I got my men through. I made an alliance with a very powerful chief and left sixty men with him. He quickly drove the whole of the enemy out of the country. The Sheik Rionga now reigns as representative of the Government.

I was anxious to find out where the unfortunate Major Abdullah, with his hundred men who were to have been massacred in the grass, were, and I determined to take my "forty thieves" and to leave the sixty men with my new ally. I determined therefore immediately to push back to Fatiko, and see what had become of Major Abdullah and my detachment. I started, and having crossed the Nile, I met men who had been sent by the chief of the country to implore me to come immediately, for the whole of the slave-traders had intrigued against me. They had heard that I had been massacred. These slave-traders therefore intended to collect together to attack the hundred men under Major Abdullah, to massacre them, to take all the ammunition and effects, and to spread the reports (which came to England) that we were "already murdered "by the natives." We marched as fast as we could, and passed through 78 miles of wilderness. When I arrived within ten miles of my station in this lovely paradise, Fatiko, I came to a village where the natives had collected, having heard of my intended arrival. The chiefs laid their case before me. They said, "If you are a Government "why do not you protect us. You offered us protection, and "we have sworn allegiance, but you have only left one hundred "men to represent you, and we are pillaged and murdered by 1,100. "Now we believe in you still, but show us your power to protect "us." On the following morning I started early, and when I arrived at Fatiko I was like one risen from the dead. I found the detachment there; for the King's arrangement to murder them had failed; they had only killed eleven of my men on the march. Instead of keeping quiet and carrying out the King's orders, they got into a squabble with my men, and the plot broke down before the appointed time. I found the major with his detachment and all the *matériel* quite safe. No sooner had we embraced, than a withering volley was opened upon us from these scoundrels of slave-traders, who were in camp 270 strong, no more than 90 yards distant. Seven men were knocked down immediately, and we should have lost a large number, as the men, being dressed in scarlet, were a fair mark, and closely packed together. However, my "forty thieves" were not pleasant people to fight with; and the instant the attack commenced, it was only necessary to sound the advance with the bayonet, when the forty, leading the charge, broke up the 270 rebels, and in fact crushed them at once. In rebellions, I do not like hanging people after the fight is over; but at the same time, when troops are called out to act, I think it is as well to let them act thoroughly, and not to sound the bugle to "cease firing" until a severe lesson has been given. I was determined, as this rebellion had commenced, that the bugle should be

perfectly silent until I should sound "the assembly," and therefore the fight continued. Out of 270, 141 were left dead upon the field, and 43 were captured as prisoners, 306 cattle were taken, and a number of donkeys, the latter being a most valuable prize. This was a very fortunate affair, because it almost terminated the expedition. It raised the Government troops in the eyes of the natives, and drew them towards the Government at once; and from that moment I really had very little difficulty. If I had wanted 50,000 men I only had to hold up my hand. I arranged with them that they should not attack the other slave-traders, but I so managed that I formed an irregular corps of 300 of the best of these people, and drove the rebels entirely out of the country. Some of the slaver chiefs were shot during that action, and altogether it was a victory, not only physical but moral. The whole country was at peace, and the delightful reward was, that after so many difficulties, it was not only peace, but perfect prosperity. I established a corn tax, and the natives paid it with the greatest good will. When I left, they were cultivating an immense country.

To show the difference of command, I had sent for reinforcements to Gondokoro, 160 miles distant. 300 men were coming up to me as reinforcements through a country which I had passed through without firing a shot. The *morale* of my men was perfect, but these 300 new men, during their march with an Egyptian Colonel, actually got into a row with the natives on the road, were defeated, and lost thirty men killed, and all their arms and ammunition taken; thus all the good work that I had done, appeared to be destroyed. When I returned, I fully expected to have had to fight my way back; but the natives never attacked me. I marched through the country, as I would march through London, in fact without being jostled.

Throughout the late expedition I have been ably assisted by Lieut. J. A. Baker, R.N., who has upon all occasions upheld the reputation of the noble service to which he belongs.

Your Royal Highness, I have already trespassed too much upon the time usually permitted, but having given this simple and short description of some incidents that have happened, believe me, I do it without the slightest presumption, trusting that out of so much *débris* of matter, those who are practical, and belong to the military profession, may perhaps find one or two grains worth collecting.

The Chairman: Sir Samuel Baker and gentlemen, I am sure that I am expressing the sentiments of this large and important meeting when I say, that we highly appreciate the very able manner in which you have brought to our notice in a very short period so many interesting details in connection with the duties upon which you have been engaged. There is nobody in this room, there is nobody in this country who does not rejoice to see you amongst us once again, and able to give us an account of the very extraordinary power which one man has had over such vast hordes, all of whom, as far as I can make out, were originally disposed to take anything but a favourable view of the leader sent amongst them. Now, gentlemen, there is one point in all this which I think gives us great hopes for the future. We have dealt to-day entirely with the great undertaking which you,

Sir Samuel Baker, have brought to so successful an issue; but we cannot divest our minds of the fact, that we are at this moment engaged in some serious difficulties somewhat similar to those which you have just described. We know what one Englishman has done under those circumstances. I think we may have confidence that not only one, but many Englishmen, will endeavour as far as possible to emulate the doings of our distinguished traveller. This gives me confidence that we shall not have to deplore anything in the shape of failure. On the contrary, I look hopefully to the future; and although no doubt the difficulties we have to contend with are great, I am satisfied that we have had in our day and in our history many such difficulties that Englishmen have overcome, and I believe the Staff, the individual English Officer and the English soldier are quite as equal to the occasion, as they have been before. What we have heard to-day satisfies me that that will be the result. I think we ought to have implicit confidence in those who serve us in various parts of the world. We know what has been done in India, and what an empire we have founded there. Why should we be afraid that we cannot do now what history tells us we have done before? Prompted by that spirit of enterprise, by that spirit of honesty and straightforwardness which has characterised your proceedings, I am sure that the Government of this country will be able to bring to a satisfactory issue those difficulties in which at this moment we happen to be engaged; I therefore feel most grateful to you for having brought this subject so specially to our notice. I only regret that many of the valuable hints which you have been able to instil into the minds of those who are sitting round you, cannot be at once carried to a distant land, there to be made use of, no doubt with great advantage, where now they are so much required. When I say this, it must be clearly understood that I give the fullest credit to those who are on the spot, and whilst I see what can and has been done by so distinguished an individual as the one who is now amongst us, I feel confident that there are others who are willing, ready, and quite equal to follow in his footsteps.

LECTURE.

Monday, December 22nd, 1873.

General SIR WILLIAM J. CODRINGTON, G.C.B., Vice-President of the Institution, in the Chair.

BRITISH TROOPS AND SAVAGE WARFARE, WITH SPECIAL REFERENCE TO THE KAFIR WARS.

By Colonel Gawler, late 73rd Regiment, formerly Military Magistrate with the Kafir Tribes.

A great many lectures have been delivered here and elsewhere on strategy and tactics in regular warfare, but, so far as I know, until Sir Samuel Baker delivered his admirable lectures, nothing of the kind had been attempted on irregular warfare, although, owing to our wide and scattered empire, and our constant contact with uncivilised races, there is no nation more constantly involved in little wars than ourselves.

No one who heard Sir Samuel Baker's lectures could fail to have been struck with the great difficulties he had to contend against, and how much more serious was his work, in having (beyond a dozen or so Europeans) only native troops to depend upon. I know well the loneliness of the feeling of being in command of people not of one's own blood, when they compose the bulk of one's force instead of supplementing it, and when in addition to other anxieties one knows that the courage, sympathy, and loyalty of the force is very evanescent and ready to take wing at very little provocation.

These I say were among Sir Samuel Baker's difficulties, and he proved himself equal to the occasion; he also illustrates the truth of an observation (at any rate in savage warfare) that the best sportsman makes the best soldier.

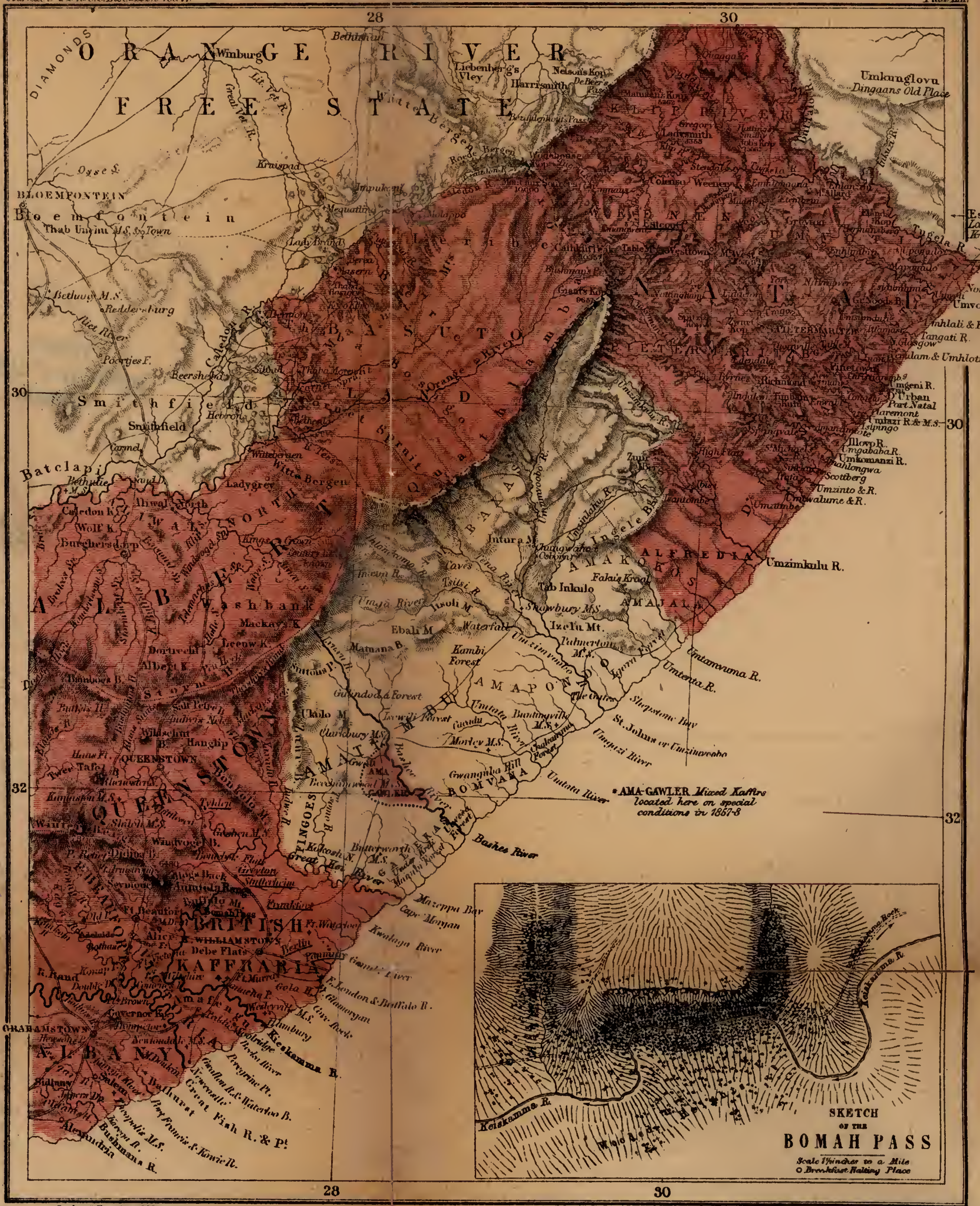
The task before me, however, besides endeavouring to show the principles of savage warfare, is to point out how far the British soldier is capable of competing in that line, from experiences drawn principally from the last Kafir War.

Before engaging the enemy, however, I will glance over a few preliminaries. In modern regular warfare, I need scarcely remind anyone, an immensity of science is brought to bear, and the army that is best equipped and provided, ought to win; but on the other hand, its requirements are enormously increased—communications must be

MAP TO ILLUSTRATE COL. GAWLER'S PAPER ON SAVAGE WARFARE.

Journal of the R. U. S. Institution Vol. 17.

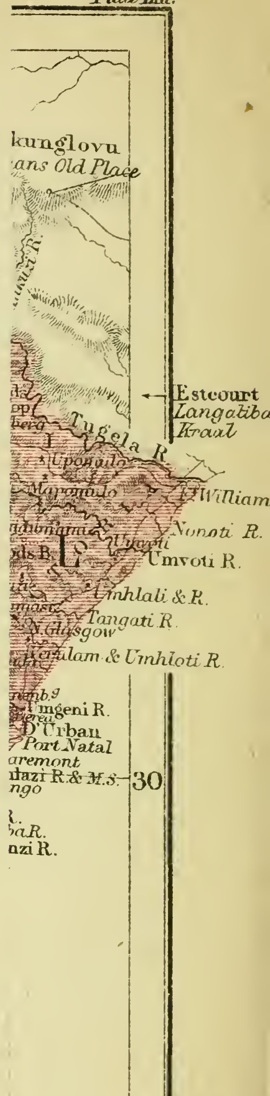
Plate LIII.



Scale of Eng. Stat. Miles.

Stanford's Geog. Estab. London

Plate LIII.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good and supplies handy to give that expensive and elaborate machine, a modern army, rapid development of its powers and full weight.

Herein often lies the difficulty of dealing with an uncivilised enemy. He generally occupies a poor or difficult country where your scientific appliances are an encumbrance, and even parts of your system unsuitable, and he thus considerably reduces the odds against himself, and the war, for the first part at any rate, is a mere trial of the animal instincts and physical abilities of one race against another; your time and labour are consumed in surmounting the difficulties of the country, in proportion to the impedimenta and novelties that you choose to carry with you.

On the other hand, an enormous amount of time and money is saved in proportion as an army in such a country is able to divest itself of all impedimenta, except what are absolutely required to keep up supplies of food and ammunition and to maintain its health. An uncivilised country cannot be made to receive all at once the appliances that could be made use of in a civilised country; and to crowd an endless variety of stores into a country where the landing and storeage room, means of transport, roads or footpaths are too limited to receive them, tends either to a waste of money and much destruction of stores which are in everybody's way, or to the prolongation of the operations until the country is made fit for their utilisation.*

For the ordinary operations of savage warfare, artillery is not required. It is useful for the defence of camps.

In New Zealand, guns were valuable in attacking some of the formidable pahs.

In the Himalayas I took two howitzers with me, but only because the mortars which I had sent for had not arrived. I wanted these for the attack of the very formidable positions which frequently occurred.

In the Kafir War, guns were of little use, except in attacking certain strongholds, and in Basuto land.

Savage warfare consists for the most part of skirmishing over difficult country, bush or rocks; and guns are only of use, when the enemy crowd together in a position, which is not often the case. Guns, moreover, confine your movements to the good ground and main roads, which the savage as a rule avoids; and in a dense country there really is not scope for a gun, and rockets do all the frightening that is necessary, and are more portable.†

On the subject of tents, I think, if the season be not rainy, and if the country afford the means, it is better to let the men bush it. Sir Samuel Baker's suggestion quite coincides with Cape experience; each man should have a hatchet, and two or three can knock themselves up shelter against all but very heavy rains. Indeed we were out for six weeks at the Bashee in the Kafir war. It rained the whole time heavily, and the men had no shelter but what they knocked up for themselves, or a patrol tent improvised out of one man's two blankets, which two others shared with him. Officers had patrol tents.

* This was a note made during my expedition in the Himalayas in 1861.

† Hale's rockets can be fitted with bursting shells, and the 24-pounders attain a range of 7,000 yards.

When I assumed command of a field force in the Himalayas, one of the first things I sent for on arrival at Darjeeling was hatchets, and they did not arrive a bit too soon. The 6th Royals arrived at the barracks at Sinchal at nearly 8,000 feet elevation—dreadfully cold, and snow was on the ground. The wood contractor failed to fulfil his contract, and the men, though surrounded by a magnificent forest, were perishing in the midst of plenty for want of axes to cut it with.

On the subject of arms:—

In a country of dense jungle, or where the enemy only fights in the bush, I concur with Sir Samuel Baker that the breech-loading smooth bore, which will carry the old musket ball and six to eight slugs, is the best weapon, and a proportion only of rifles; but I do not attach sufficient importance to it, to advocate a change of armament for regular troops sent on such service. Local corps do well to consider such matters. The Cape mounted Police were armed with a double barrel, one smooth and one rifled. In open countries, as Basuto land, the long range rifle is indispensable.

On patrol during the Kafir War, the men, besides their blankets, repeatedly carried three days' biscuit and groceries, so that the slaughter-cattle and Officers' pack and riding horses formed the sole impedimenta. The men also carried groceries for ten days and biscuit for three, and the balance of the biscuit was carried on pack mules—one mule carrying the biscuit for about 30 men for the remaining seven days.

This leads me to the subject of horses and mules; and in this also I concur with Sir Samuel Baker on the desirability of having at least a few mounted men even in a dense jungly country. Apart from any fear which some savages have for horses, it is most important to have a small body of men that can move rapidly; and I have seen very few jungle paths in the Himalayas or the Cape, where horses could not be ridden. It is also most desirable that Staff and Regimental Officers should be mounted; the former certainly, and as for the latter, their work often only begins when they reach camp. In the early days of Natal, before the tribes had settled down, the 45th Regiment which was stationed there, had one company mounted. I don't know why horses are not supposed to live on the Gold Coast, but, if it be that the rank grass is unsuitable, it might be got over. In parts of the Himalayas where there is no grass, horses, cattle, and goats live luxuriously on bamboo leaves, and bamboo seems to abound on the Gold Coast.

I was glad to hear that a portion of the European force in the Ashantee expedition would start from Accra, which is a route well suited to a European force. It is five days longer, but horses live there, and they might therefore have mule transport. Moreover, it starts at once with an elevation of 1,600 feet, the climate is healthy, and European vegetables are procurable.

This properly is a branch of strategy on which I will say a word or two, for in savage warfare, strategy is just as important as in regular warfare. The first point in strategy is to discover wherein, like Sampson's secret, lies the strength of the enemy, and his power to maintain the war.

Savages have so few impedimenta that they are as slippery as eels, and their system consists chiefly in evading your blows, and in administering what may be described as mere stings. The real gravity of the war, is the expense attendant on its long duration, and the great labour and hardship for the troops.

In Sir Charles Napier's campaigns against the hill tribes in Scinde, certain wells of water, a stronghold named Trukkee, and their cattle and camels, were the enemy's tender points. The enemy were gradually forced into Trukkee, and surrendered when they found it turned.

It is more difficult, however, in a country like Kafirland or Ashantee, to ascertain their tender point.

In the former country, the enemy's cattle is *one* object; but the climate is good, and he can live without shelter. There are plenty of streams, and *numerous* difficult localities where he can hide; and this, when the enemy's country is backed by tribes with whom we have no quarrel, but who, ignoring the duty of neutrals, allow our enemy and his cattle to take refuge with them, is embarrassing.

The best system under such circumstances is rapidly to seize by forced or secret marches, if practicable, any passes or lines of retreat, and to sweep the country, in columns of from 300 to 500 men, operating in connection with each other on parallel or convergent *main* lines, upon some obstacle, as the sea, a deep river, or towards more favourable ground, as open country; for concealment is really the mainstay of the savage.

In the Kafir War of 1850—3, we commenced with an inadequate force to patrol the country in a desultory sort of way, and we had also to keep numerous posts provisioned. The Kafirs would amuse themselves by attacking the troops whenever they saw that they were encumbered with anything that they could not well leave. On other occasions they would yield as the troops advanced, but follow up with vigour on flanks and rear, as soon as want of provisions made it necessary for the troops to return.

As our force was increased, patrolling thus from towns and posts, forced the enemy into strongholds, as the Amatola Mountains, the Waterkloof, and Fish River bush; and when large numbers were congregated in such places, battues were organised, or camps established in them, and waylaying resorted to; we also prevented their cultivating anywhere. But although battues, patrolling and waylaying were generally well managed, it was desultory, and I did not see a good combination of them all by the whole force acting in concert on some definite plan.

In Ashantee, I am inclined to think that, though their dwellings are temporary and their baggage light (though not so light as that of Kafirs), the enemy will hold more together, and will give better opportunities for inflicting *blows;* and I think we may reasonably hope that the war will not degenerate into that most difficult and unsatisfactory sort of guerilla warfare, *i.e.*, the action of small parties of the enemy independent of each other, living anywhere, and fighting or annoying us when they like and where they like.

From this we see that anything which will draw a savage enemy

together, is in our favour, whether it be a stronghold, as in parts of Kafir land (so long as it is not of too great an extent), whether it be a New Zealand pah, or whether it be an attempt at organisation on the part of the enemy; for their being drawn together furnishes us with the opportunity of delivering *a blow.*

Savages by attempts at organisation, generally render their movements comparatively heavy.

I now come to the main point of the present lecture, viz., to show how far the British soldier is able to compete with the savage in bush-warfare.

A Kafir war, like most other wars with savages, in its tactics or details, may be described as a war of stratagem. From inferiority in weapons and organisation, the Kafirs, like other uncivilised races, are unable to meet a civilised force face to face. The introduction of breechloaders has made this still more apparent; and, whatever difficulty there may be in catching the enemy to administer a blow, a party of 100 Europeans with breechloaders should now be perfectly safe against enormously superior numbers of savages, unless, of course, the latter possess themselves of similar weapons.

Kafirs are individually brave, and devoted to their chiefs, but like most wild animals, a few will often make a much better fight in proportion than larger numbers. You may chase a herd of buffalo with impunity, as long as your horse will last, but put up two or three old bulls, and they will provide you with occupation.

I may mention as an instance of courage and devotion, that a small party of my Kafir police, under Colonel Colley, had attacked a notorious old warrior and bandit, named Tola, who, with his three sons, and some dozen others, returned the charge, and followed them up fiercely. The police having sent for a reinforcement, taunted the old fellow whenever his party showed signs of giving up the pursuit, and thus drew him on. The re-inforcement arrived, Tola and his three sons were killed, and his men fled, except one old counsellor, who stood alone. He received a call to surrender by wounding with an assegai, the policeman who made it, saying, "I left my kraal with my Chief this morning, and will not return without him." He fought desperately until he was killed.

As a rule, however, selfishness and want of discipline, make the individual savage generally feel that he bears the whole brunt of the battle. His comrades are of little account; he does not rely on them. Hence each man looks out for himself, and decamps when he is so minded.

In the war of 1850—3, the Kafirs were well supplied with arms, of which a great many were percussion, and they were tolerably supplied with ammunition.

To induce a savage to fight, it is a *sine quâ non* that he should have large odds on his side, and that he should be free to withdraw when he pleases. The odds are of course in his favour if he can carry on the fight from under cover, while his foe is in the open. His fondest wishes

are therefore thoroughly gratified by any Officer who, when attacked, keeps his men outside the bush, as on the path, or in the open.

The only effectual plan is to dash at him and unearth him at once; 1st, because, like many better troops, he does not desire close quarters; 2nd, because his party do not actually count on more than their first volley. If that fails to confuse his enemy, or make him pause, his scheme is frustrated, and he has no discipline to enable him to arrange another in time.

His volleys are generally delivered at 80 yards and under, and for troops to pause at one of them, or anything but a forward movement, is to prolong the fight and multiply the risks. Kafirs and Hottentots were often cool enough, after delivering their shots from the edge of the bush upon the troops approaching it, to lie still to observe the effect. If the troops halted and took cover, the Kafirs were quite equal to keeping up the engagement, and took their shots deliberately as any man showed. But if the soldiers dashed straight at them, they disappeared at once, often with loss; for the soldier's eye soon becomes accustomed to the moving branches and twigs indicative of a retreating nigger, who gets more bullets after him than he likes, and becomes very shy of ever waiting again to observe the movements of a foe, who he knows, will come straight at him.

British soldiers can go through anything through which a Kafir can go. They may have to leave bits of their clothes behind on the thorns, but if so, the Kafir leaves bits of his skin. Soldiers soon leave off the regulation attitude, and learn to duck and twist and tear through the more yielding portions. There is no occasion to dash through the middle of a thorn bush; although on one occasion, on the coast near the Bashee, where the bush is stunted and thorny, with strong boughs only about 18 inches from the ground, a sergeant of my company ran a Kafir into it, crawled after him and pulled him out by the leg.

As to the advisability of a line of skirmishers, who are coming across the open towards the edge of a jungle, firing into it whether they see an enemy or no, I have a word to say. In the Kafir war a very excellent and brave Officer adopted such a system in his regiment, but in what I may call slow time and in close order, which was fatal. He formed line in the open within 80 yards or so of the bush and fired volleys into it. The Kafirs and Hottentots lay close, and after each volley rose and took their shots with sad effect. The commanding Officer and several men were killed.

I see no objection to a *few* men, of a line of skirmishers who are running towards the bush, discharging their rifles into it, as if they saw the enemy, who, if he be there, will think that he is discovered and will run, but the forward movement must be unchecked and as rapid as possible. My experience, however, is that the men will do it in spite of orders, and will always declare that they saw an enemy. To sanction the practice would render it intolerable, and the men would hang back. To discountenance it strongly, just reduces it to reasonable limits. Musketry instructors, however, must not lament over bad shooting and numbers of rounds expended when there has been no enemy to hit.

Of stratagem, waylaying and surprises are the commonest forms.

The Kafirs were two or three times very successful in waylaying large bodies of troops. I will mention one instance,—the Bomah Pass,—not as a specimen of waylaying, for there was a mixture of treachery, but to show how we might have acted.

Although a sergeant's party on escort had been waylaid and murdered, Sir Harry Smith had not yet proclaimed war, and Sandilli was the only Chief who did not obey Sir Harry's summons to appear, and he only pretended to be afraid.

Sandilli was in the Amatola Mountains, and a large camp was posted to cut off his retreat to the Kei, and a patrol was ordered by Sir Harry Smith to move from the other end through the Amatolas, not to fight, but as a military promenade, to intimidate him. So much was this the case, that the men were not allowed to loosen a single packet of ammunition. The whole of the country was difficult, and there were only footpaths. The force consisted of a large number of Cape Corps, Kafir police, and I think six companies of European Infantry, including one company of the 73rd. There were the Officers' packhorses and two packhorses with spare ammunition. The troops breakfasted about half a mile from the entrance of the Bomah Pass, and several Kafirs and their women came in selling milk in a most friendly way. After breakfast, the force moved into the Pass. The footpath, which was only wide enough for single file, was through very dense bush,—trees and underwood,—with large rocks here and there by the edge of the path. There was a precipice to the left, and the Keiskamma river flowed about 60 yards down on the right. The river was unfordable just there, or at any rate fording was very difficult. The length of the Pass properly so called (*i.e.*, the densest part, having the precipice on the left and the river on the right) was a little over a mile. The company of the 73rd was in rear, and when the Cape Corps had just got out at the other end, the rear guard was entering. So far all went well, and there was a momentary pause. Presently a shot was heard, then two or three. Then word was passed down to loosen one packet of ammunition but not to load, and afterwards to load but not to fire. At the first shots, the men came down on one knee and remained perfectly steady, and anything might have been done with them; but those were the days when company Officers dared not act without orders, and the Officer commanding the infantry was a mile off, and could not possibly estimate where the tail of his column was. Firing continued and was returned, and presently a bugle sounded from the head of the column "the advance" and "the double." If the bugle meant that the men were to face their foes and advance, all the Kafirs would have been swept into the river if it had been acted on, and there would have been no Kafir war; but it was understood as an order to proceed, and the tail of the column had the whole Pass through which to run the gauntlet. All the packhorses that had not already emerged from the Pass, including the two with ammunition, were lost; but only ten soldiers were killed, so busy were the Kafirs in looting the packhorses.

This is not a fair specimen of waylaying, as it was mixed up with

treachery, and the force was unconsciously led into a trap; but I mention it to show what might have been done. Some months later the 73rd marched through the Pass, and my company moved without any difficulty from one end to the other in skirmishing order through the bush, with one flank on the river and the other under the precipice. (Since then a good waggon-road has been driven right through the Pass, and the Amatolas are no longer a stronghold.)

Should an Officer by accident or neglect ever find himself in such a position, the only safe plan is to dash straight at the enemy. Keeping on the footpath, and firing as you moved along, might clear long grass or mere underwood of men *standing* in it; but if those were your tactics, Kafirs are quite cool enough to lie down within two or three yards of the road behind logs or stones, quite concealed, and the force would run the gauntlet past them, and its fire would go harmlessly over the enemy's heads. Moreover, your own men going along in single file would not know when the danger was passed, and the firing, which had been provoked by perhaps a dozen of the enemy, would be kept up for a mile or two.

Supposing, moreover, that you got through the Pass without loss, what effect would such proceedings have on settling the campaign?

The object of a campaign must consist of something more than seeing how often you can run the gauntlet past an enemy.

In my humble experience, the dash of those nearest to it, straight at the ambuscade not only scares the enemy at the moment, but gives him a lasting respect for you.

But (excluding an affair like the Bomah Pass, which was partly treachery) I will lay it down as a rule that a British force should never be surprised either in camp or on the march.

In the Himalayas, I always reconnoitred in small parties in all directions to long distances, and frequently by night. On such expeditions the parties should notice all sounds and footmarks, *and should be on the look out* for anything that could indicate whether anyone had been in the neighbourhood recently.

There is nothing so foolish as to go to sleep without knowing whether the enemy may not be within half a mile of your sentries.

On the march by footpaths through a dense country, half-a-dozen men at from 50 to 100 yards in front and the same in rear, will serve the purpose of advance and rear guard; flank patroles should move if possible within the bush, but sometimes this, owing to the underwood, would be too much of an undertaking. In this case the leading file must turn to the right, get as far as he can into the bush, kneel and look well under the bushes; the next file in about five paces turn to his left, the next to his right, &c. Thus the whole force is inverted, and extended on both flanks at ten paces; as the rear guard approaches, the files rise in succession and close by sections, moving along between halted sentries. I am told that something similar is recommended in a work by Marshal Bugeaud, and I think Sir Samuel Baker practised it; but I first saw it done in 1851 by Colonel Eyre, in going through a ravine in the Fish River bush, where a large number of another regiment had been killed two or three days previously.

In going through nasty places, it is quite possible that you may be followed up, and seriously annoyed, and it is surprising what a tendency there is under such circumstances *to hurry*. Discipline, however, is something to fall back upon. A little ready action should be taken to meet immediate necessities, and to gain time to make more suitable arrangements.

On one occasion we were leaving the Amatola basin by a footpath through an intricate bit of country, commanded more or less on all sides from slopes covered with dense forest and underwood, from which flank patrols could do little to protect us. The Kafirs were following us up on flanks and rear, and there seemed a disposition on our part to move more quickly than Colonel Eyre thought dignified. He, moreover, was evidently anxious. To recover himself and restore coolness, he gave the order, " halt, lie down and smoke your pipes." The men lay here and there by bushes and rocks facing in all directions. The exultation of the Kafirs vanished, and in a few moments of comparative quiet, Colonel Eyre devised an offensive movement upon them.

Against an uncivilised enemy, surprises ought to be more practicable than against the civilised. The savage has not the system, sense of duty, or persistent energy, that British troops should have, nor is their work supervised. And it may be laid down as a rule that, if the surprise is complete, their rout should also be complete, because they have no discipline to fall back upon, *i.e.*, when their first arrangements are broken through, they have not the power to rally; but this supposes that a surprise means something more than a momentary fright. It is the difference between winning a victory, and making use of it. It is not sufficient to creep stealthily up to an enemy who is sleeping or feeding, and merely startle him. Don't then imagine that you have won a victory! To advance with a British cheer is a grand mistake. I once fell into it myself when, with a party of Umhala's Fingoes (a race inferior to, and in subjection to the Kafirs), I went to surprise a kraal. We had done our night work beautifully, and in the glimmer of the morning could just distinguish the doomed kraal 150 yards off. The rush commenced, and, as the Fingoes went skimming swiftly over the dewy grass, I gave a shout of exultation when within a few yards of the huts. The enemy bolted out of their huts into the opposite bush, and then turned round and shouted the war cry in return, and to some purpose, for I was not prepared to follow them up, and in a quarter of an hour we had to make our way back again with the whole country side after us.

I made two deductions after this mishap, upon which I acted ever after.

1st. When you intend to surprise an enemy, do not *reveal yourself*, but go on quietly and coolly completing your plans until the *enemy* finds *you* out. More correctly, the object should never be to *surprise*, but to *entrap*. In the case I have quoted of myself, the party was rushing forward silently to place themselves some over the doors of the huts, while others would have occupied the bush beyond. My shout *startled* the enemy certainly, but he got away, and, as I was not prepared to follow him, he rallied.

In an ordinary attempt of the kind, on a place surrounded by bush, as soon as it is observed, parties should creep silently round to the right and left, keeping just within the edge of the bush, and they may sub-divide themselves again, to waylay any paths or occupy any favourable points on the opposite side by which the enemy is likely to run. When a few minutes have been allowed for them to get into position, if the enemy be still undisturbed, a strong party may run silently up to the huts; three or four men with bayonets fixed to every door.

If he should still remain unconscious, the form of introduction might be an embarrassing point, but I confess I think I should gently explain the situation to him, and ask him to surrender.

2nd. The second deduction is, never to undertake a morning's job without being prepared (with provisions, &c.) to spend the night from home. It is just *after* the surprise that the real work is likely to begin, if you have failed to entrap him, and you should be prepared to follow him up, or at any rate to assume the offensive if he should presume to follow and harass you on your return home.

This was the most annoying part of three-fourths of the patrols during the early part of the Kafir war. The troops were tied in their movements, and were bound to certain directions and to reach certain points. The Kafirs quite appreciated this, and harassed the flanks and rear.

We now come to waylaying and reconnoitring, and a few of their details.

This, in bushy country especially, is best done by small parties of from a dozen to thirty men; sixty men would be very large, and in a dense country, unwieldy and unnecessary.

British troops are very apt scholars at any exciting work. There may be some obtuse, clumsy fellows, who can never learn to speak in a whisper, or to tread lightly, and who, over rough ground, or among tangled creepers, are always tumbling about, and making a row, but, as a rule, nine-tenths of the men are the very best material you could desire. They must learn to move along silently, all eyes and ears; a sort of stealthy stroll is the best pace for the purpose. Eyes should be on the bush, to mark if any branches, twigs, or creepers have been disturbed by anything going in or out; on the ground, to detect any footmark; and experience will soon teach men to decide whether marks are old or recent. As a rule, in bush you obtain a better sight, and can see further by stooping and looking among the stems and trunks. At a noise, or rustling, or any marks, the party should pause and consider, not in a clump in the middle of the path, but edging sideways, quickly and softly, within the bush. They must consider whether the enemy is coming, or going, or halted, whether he has seen them, and, above all, whether from the marks, it is likely that one or more of the enemy have been already passed, lurking in the bush.

It is impossible to enter into all details. To be all eyes and ears, perfect silence, and concealment, *whether resting or on the move*, form

the pith of it all, and experience finishes the education. Ready wit in hitting off good plans, so as to make the most of the situation, is a gift.

One or two general rules on waylaying may be given.

Never waylay very near to the point at which you leave the road or path. If you have reason to think that an enemy is following you, quit the path at some favourable point when he is not in sight, and return within the bush, parallel with the path for several yards, to some point where there is good concealment, for of course if he were to come upon your footmarks, leaving the path, your scheme would be spoiled. This is a common trick of the buffalo. He will run straight away, and on turning a corner so that you lose sight of him, he runs rapidly back for 200 or 300 yards within the bush, and charges you in flank as you pass.

For similar reasons, when advancing to waylay, always leave the path and move within the bush parallel to it, before selecting your position.

If the path be along the side of a hill, choose the lower side for your party; 1st, because an *up*-shot is best, particularly at night; 2nd, because if you were on the upper side, the enemy would have such an easy retreat by dashing down through the bush on the lower side.

No smoking should be allowed, but the men should have cold tea, or spirits and water, and some biscuit in their havresacks, and a bit of cooked meat or cheese.

It is a good precaution, particularly for small parties moving in the neighbourhood of the enemy, or when returning from waylaying or reconnoitring, never to return to camp by the same route by which they went out. Besides enabling you to see more of the country, it upsets any plan the enemy may perchance have laid for you. When I was a magistrate with the Kafirs, when riding alone I was three times waylaid, but my sticking to this rule saved me.

As to what may reasonably be endured: in the expedition across the Kei, in 1851, the troops for a couple of weeks had, besides their coffee and sugar, only their meat ration and *Indian corn*. The biscuit had run out.

In my expedition to the Bashee with Kafirs, Colonel Colley and I lived for some days on beef and nettles, and I have been out for 48 hours with only biscuit, and I dare say there are many besides myself who could relate greater privations endured for the mere love of sport and adventure.

From a military point of view, these things read like bad commissariat arrangements; but no; on special enterprises you carry supplies with you, and abandon your communications, and, if you meet with more than you expected, it is better to use a little ingenuity and self-denial, and make a good job while you are about it, than to return leaving it half finished, because your supplies are short.

I cannot dwell too strongly upon the importance of Officers and men rapidly acquiring a knowledge of the country and all its roads, foot-paths, villages, streams, &c., and, for this purpose, an efficient staff of field sketchers should be employed in a country not already known. At the Cape we had an admirable map by Colonel Jervois, of a portion of the seat of war; and at a later period, my friend Colonel Colley made

a beautiful and minutely accurate survey of the country between the Kei and Bashee, but I fear that it is at present decaying in the Survey Office at King William's Town.

I will now give a few specimens of the work of small parties.

During the Kafir war, when the power of the Kafirs was a good deal broken, and the Chiefs were lurking with comparatively small numbers in the densest parts of the Amatolas, Fish River, Waterkloof, and Kei, Colonel Eyre, with the 73rd and 43rd, had a standing camp in the Keiskamma Hoek, in the middle of the Amatolas.

The Kafirs could not live altogether on nothing, so they always had parties out thieving, or bringing supplies of corn, &c., purchased among friendly tribes (although I was told by a Kafir after the war, that when acting as spy he lived for three days on his sjambok). Sandilli himself was believed to be in the Amatola basin, and small parties in the Wolf Valley. Colonel Eyre detached my company, about 60 strong, to live in the bush on the Wolf ridge, and to draw supplies every three or four days from the main camp, and I had permission to do as I liked. If I had done nothing, I have no doubt that in two or three nights I should have been attacked. But I thought that if any fun was to be had, it would be while the ground was fresh. On the first evening I took a sub-division, and went along the ridge, about a mile, to above the Bomah Pass, and took 12 men down and posted them, to waylay it. As it was a nasty place, I promised to come to them at night, when my other work was done. I then went back with the remainder of the men to camp, and took out the other sub-division in the opposite direction, and posted three parties, two of 10 men, and one of 6, waylaying three different paths. It was quite dark, and I returned to camp with a few men. After dining there, I went alone and joined the Bomah Pass party, as I had promised, but we passed a quiet night. In the morning I found that two of the other parties had made their bags of several Kafirs, and had captured two horses laden with corn. The corporal in charge of the smaller party had managed rather cleverly. The path was along the side of a hill, and his party was lying on the lower side. Several Kafirs came past, and he fired and then charged. Three or four Kafirs were killed, and the others dispersed. The corporal and his men kept together, got on the path again, and ran quietly down it for some distance, and waylaid again. The Kafirs in their turn began to feel for the path again, to continue their journey, and presently a single Kafir, acting as an advanced guard, passed the corporal's party. They let him go by, and the others came along and got another volley and charge, by which two more were killed. A prisoner, taken by one of the larger parties, told us of Sandilli's whereabouts, and Colonel Eyre drew out his whole force at once, and enclosed a vast extent of country, but the news had also reached Sandilli, and he got clear out of the district.

In 1852 the Kafirs had congregated in considerable numbers in three or four places in the Fish River Bush. This is a tract of low, intricate country, from three to ten miles wide and fifty miles long, through the middle of which the Great Fish River winds. It is covered with dense bush, and from the margins of the high ground come long and tortuous

ridges, forming necessarily numerous intricate ravines and valleys, affording excellent concealment for large bodies of Kafirs; plenty of wood and water, and a few small, open, grassy patches where they could graze a few cattle. This place was their base, and from these various camps they used to send forth marauding parties upon Lower Albany and the neighbourhood of Graham's Town. Colonel Eyre was sent with four companies of the 73rd and some Cape Corps to protect those districts. He formed five camps, from two to three miles apart, in select corners on the high ground above the bush. The Officers commanding these posts made themselves acquainted with every road and footpath entering the bush between them and the neighbouring camps, and for long distances into the bush. Daily patrols detected if anyone had been in or out, and parties moving off at dark spent the night in waylaying. At first the excitement was great and the bags large, but the Kafirs soon thought it too hot, and made their depredations in other directions. Then, without abandoning his line of camps, Colonel Eyre used to send parties of 30 or 40 men off to long distances with three days' provisions. These used to remain during the day at a little distance from the path to be watched, under rocks or cliffs, leaving one or two men on the look out at the edge of the path. Near high, blueish rocks, or among very tall trees, fires might be lit, as the smoke loses itself, but among low trees or bushes the men were not allowed to light any fires by day or night. These parties had several successes, and the Kafirs abandoned the whole of the Fish River Bush that was within our reach.

But it is not by single efforts that great results are to be obtained. I have often thought that if two other regiments had been spared for a time on the same job, posted in similar fashion to ourselves on the opposite side of the Fish River Valley, and above and below the principal Kafir laagers or camps, and if all had worked on the same plan in connection with each other concentrically upon the Kafirs, moving forward the camps and narrowing the circle gradually, waylaying, watching, and patrolling, we might have settled more effectually in ten days, what took us three months, and the Kafirs, instead of abandoning the place to maraud elsewhere, would have been *caught*.

In my own district in Kafir land, after the Chiefs had compelled their people to kill all their cattle and destroy their corn, those who did not die of starvation or go into the colony, broke up into knots of banditti under favourite Chiefs; and the people who had opposed their Chiefs and had refused to kill their cattle, placed themselves under me, and with them I set to work to break up or capture these knots of banditti, and I found that by watchfulness, patience, secrecy, and some hardship, the concentric action of small parties from a wide front (the extent of my district gave me a front of 30 miles towards the disturbed parts), was most effective, and we captured or broke up the whole of them.

In the *United Service Gazette* I read a journal of an Officer in the New Zealand War. He describes some excellent practice in waylaying and ambuscades, but these appear to have been from stationary posts, and their influence could only extend to a certain radius, beyond which

the troops must either be encumbered with supplies, or run the risk of being compelled to fall back, with the enemy harassing them.

Such warfare in fact, to be successful, must be like driving game with a long line of beaters; but in their advance these beaters must be fed, relieved, supported, &c., and no gap left for the game to break through.

Night marches are most useful and effective, though somewhat difficult to conduct when the route is by footpaths through bushy or intricate country. The men in rear stumble if the head of the column moves at an ordinary pace, and the march is often broken. A man falls, jumps up, and having lost sight of the man in front of him, runs ahead, misses a turn in the footpath, and those in rear follow him, and presently two-thirds of the force find that they are following Private Thomas Atkins, who has not a notion where he has got to.

I did a great deal of night work in the Himalayas, and the marches were generally very successful; but on one occasion I found I had lost my tail, and went back. Presently I heard the voices of the lost ones, and waited a little for them, but they came no nearer. I went on to them, and found about twenty walking round and round a clump of bamboos.

However, a slow, sure pace, a sort of sauntering, leisurely pace, frequent halts, say every twenty minutes, and a good Officer in rear, will always succeed, and in a climate where the night air is not likely to injure the health, night marches will be found most valuable.

The principles herein laid down are those practised by Colonel Eyre; and by them the 73rd, though through the whole war and constantly out, suffered very trifling loss, and entirely escaped the disasters which befel many other regiments.

As regards the recent disturbance at Natal, I don't think much about it; but it is just one of those unpleasant occurrences which may arise out of a want of uniformity in our dealings with natives.

There is some discontent among the Natal Kafirs at finding they are kept tighter in hand in Natal than in other places under British rule, and one Chief has resented it by moving off with his tribe into Basuto Land, without, I understand, paying his taxes. But Basuto Land has, I believe, recently come under our control.

The Natal Government tried to stop him, and occupied all the passes with very weak parties, but the Chief forced his way through, and killed two or three Europeans of the Volunteer force.

I think it was a pity that they tried to stop him. I really think it should have been considered a boon to get rid of such a man. His location cut up into farms, was worth more than the amount due. It would have turned the laugh against him, and the other Chiefs would be very cautious about abandoning their locations in a huff. I would even have furnished the retiring Chief with a letter of introduction to the authorities on the other side of the mountains, explaining that he was a very disagreeable fellow, who required looking after, and that they were quite welcome to him.

Natal and Basuto Land are both open countries, very easy to work, and could be thoroughly managed in a short campaign by the mounted

burgher force, supported by a small force of British infantry, but the operations should be conducted by a military Officer acquainted with his profession.

The different Colonies or Governorships in South Africa would do well I think to compare notes on the native question, and as far as possible assimilate their laws and restrictions.

The natives of Natal have hitherto been well conducted; but as a people progress in knowledge and power, we must, I think, give them more freedom, or they certainly will resent the continuance of a tight hand.

The natives could not possibly maintain a war *in* Natal. They must retire on one of the neighbouring tribes and persuade *them* to go to war, but by the extension of the White Settlements, all these tribes,—Zulus, Basutos, or Amapondos, are enclosed,—and a war properly managed on our part would very soon prove fatal to their independence.

The CHAIRMAN: The subject Colonel Gawler has brought to our notice, is one of course of very great interest at present, for the war in Kafraria was very similar in its details to what is now taking place in Ashantee. I dare say there are many Officers or gentlemen here present who know the West Coast of Africa, and we shall be very glad to hear any remarks they may wish to make.

Major-General COLLINSON, R.E.: As no one seems inclined to follow Colonel Gawler into the bush, I will lead the vanguard. I have nothing to say particularly upon the subject of Africa, but I should like to put the subject before the Institution in a more general way. In the first place, I think we must express our great thanks to Colonel Gawler for the trouble he has taken in putting this question before us in so clear and detailed a manner, because I believe it to be one of greater importance than people generally imagine. I suppose we shall all allow that we are not by any means at the end of our native wars, but, on the contrary, we appear to be really only just commencing to conquer Africa; therefore, the probability is that this discussion will be of great value hereafter to the British Army. Colonel Gawler has mentioned a great number of most valuable details upon the subject of "bush-warfare" in different countries, and I think we may gather that upon the whole, there is this one peculiarity which is almost certain to be found in every native warfare, that the country will be probably exceedingly difficult for regular troops; that easy and open country will be the exception; therefore close country is the style of country we must calculate upon and prepare for. This question may be looked upon from two points of view: first, the most effective and, therefore, the most economical way of keeping the peace on the frontier; and, secondly, the effect that bush fighting will have upon regular British troops. With regard to the first point, native wars do not occur in that systematic and public manner that civilized wars do. They almost invariably originate in some trifling manner, and to a very small extent, which could probably be stopped in very many instances by a small body of efficient troops or men expressly suited to the purpose. Such a body, for instance, as has been raised in several of our colonies, like the mounted police and others of that description. I believe if there were a large number of that body located in our colonies, and on the different native frontiers where there is any liability to such an outbreak, it would, in very many instances, stop the larger wars, and keep an effective peace, as far as the settlers were concerned, upon the frontier. Probably the case that has just occurred at Natal is a case in point, where a good effective body of armed police will put an end to the question for the time being, and perhaps for ever. The second point is a more serious one for us, that of the effect of bush fighting upon regular troops; and I think it must be allowed that there is scarcely any native war in the history of the world, whether in America, Russia, the Cape, or New Zealand, that has not been an unsatisfactory war. I do not mean to say that it

has not ended in credit to the troops, or that it has not produced peace, but it has been at a very much greater expense in men and money than the thing was worth. In that point of view it would be desirable always to have the assistance of a special body of men. Now, such a body of men was employed for some time in New Zealand and at the Cape, and if there had been such an effective body of men at the present time on the coast of Africa they would no doubt have been a very great assistance previous to the arrival of the troops there. But the injury that is done by the introduction of regular troops into bush fighting is, in affecting that discipline and steadiness which we consider such an essential point in the British Army. There is no doubt the change of tactics that is going on now in civilized armies, tends in the direction of a looser description of warfare, but it is not likely ever to take such an extremely loose description as is necessary in bush warfare; therefore a warfare in a difficult bush country against natives will always have a serious effect in impairing the steadiness and discipline of regular British troops, and on that account it is, I think, extremely desirable that a very much larger number of special men should be employed, and a greater quantity of money should be expended in securing the native frontiers, wherever we found a British settlement.

Major DUNDAS, late 12th Regiment: Mr. Chairman, the last speaker has said something about bush warfare spoiling the *morale* and discipline of the troops. Now I think that has been very much overstated. At the close of the Kafir War the troops were brought in from the bush, where they had been, some two and some three years, but I do not think that when they were brought into towns like Grahamstown and Fort Beaufort, there was really any want of what may be called discipline. There really was no insubordination: in fact there was but one crime, and that was the crime of the British Army, drunkenness. It so happened that they were often out for six or eight months at a time without receiving a penny of their pay. On their return into the towns, their pay having accumulated during their absence, they found themselves in command of money, and filled the grog shops, where they got a most abominable sort of stuff called brandy, that was sold at about ninepence a bottle. The consequence was scenes of drunkenness, which cannot be conceived except by those who witnessed them. But as for any want of discipline I do not think I can recollect a single case of insubordination. The men had lived so long with us in the bush, and had been so accustomed to look up to us, that we had more control over them than if they had been in barracks. Certainly their appearance was very bad. I recollect on one occasion marching into Grahamstown with my company, where the greater part of their lower garments were made of old sacks sewn up, otherwise they might have been taken for a Highland regiment. There is one thing we must remember, and that is, that soldiers when in the bush require to be fed, and that feeding is one of the most difficult and the most interesting pieces of work that we have to do. I had about six months of it out there with 100 infantry, 25 Cape Corps, and about 150 natives, and we were supplied by waggons once a week. A more insane system could not be invented. There were two men to each waggon for waggon guard. The result was the Kafirs attacked a waggon, and shot the oxen. There was a stop immediately, the waggons could not pass one another. Shouting and firing took place from one end of this long straggling column to the other. The oxen were cut out of the waggons, some of the men were shot, and the Kafirs made away with the oxen through the bush, leaving the waggons there to be plundered at their leisure. I adopted quite a different plan. The evening before we were to line the bush, as it is called, I sent out a body of the Fingoes, my allies, who carefully erased all footsteps on the paths that led on to the main road; and early in the morning I sent out again, and if no footsteps had been seen, I knew the Kafirs were not near the bush. I therefore put men generally in places where it was likely the Kafirs would come up. It was a very difficult country, and on the left hand side of the road there was a deep ravine; it was always regarded as one of the worst places in the colony to look after. In reality, this ravine was a great safeguard, for there were only three places where the Kafirs could climb up out of this ravine and attack the road. I put a corporal and three men in each of these places, and for five months all that I ever lost by the Kafirs was one fat ox; I never lost a waggon and I never lost a man. When we first went up into the mountains, the men, I won't say were afraid, but they did not like to go into the bush. The bush

there is not continuous, but inside the outer fringe there are large open spaces, perfectly clear, where you may manœuvre in any way you like. When you come to the edge of the bush, there is a depth of about twenty yards of very thick dense bush. Once through that, and you find yourself in an open forest. Our men did not know that; they saw the thick bush, and they did not know at the time that when they got inside, they would find themselves on an equality with their adversaries. Once in the bush, and the English soldier is fully a match for the Kafir or any other native; the only thing is, they require practice, and the men know it themselves. I have walked and ridden through the whole of the bush, and to call it impenetrable, is simply nonsense. There are parts that you cannot get through, but I would engage to take 500 men through that bush if they were only taught how to do it. Our men now say that if another Kafir war were to break out, they would make short work of it. The regiments sent out from England had heard terrible stories about the bush and the Kafirs, which the colonists rather magnified than otherwise, and they had a horror of the bush. But I am bound to assert, that any English soldier will by a little practice become perfectly equal to any native I have ever seen in warfare, whether on the open or in the bush.

Captain Colomb, late R.M.A.: I should be glad if there were any gentlemen here who have a knowledge of the West Coast of Africa, and who can give us information with respect to the possibility of employing horses there. My reason for asking that is, that I have had a very large experience of a climate and locality something similar to that of the coast of Africa—I allude to Central America, Nicaragua and Mosquito territory. I happened to be out there at the time that Walker, the fillibuster, was endeavouring to conquer the country, and I was employed there some short time, and horses were of the greatest possible service. They were fed on bamboo leaves. There is another point connected with British troops in savage warfare, which I think merits some attention, although it has not been touched upon by the Lecturer: it is the danger of using rivers as a means of communication, for many disasters have occurred to British troops and British forces from using rivers for that purpose. With regard to the general question, it is worthy of note that this Institution has supplied a want which must be acknowledged by all who consider the present state of the organization of our forces and the administrative power. England embraces in the folds of her Empire more square miles of bush territory, and more savage people, than any other civilised power. It is reasonable to suppose, and past history shows it to be the case, that for one war we have with a civilised power, we have about ten with savages; yet with all our boasted reorganization, that fact appears to be totally passed over; and I doubt whether, if we had rumours of disturbances within our territory in New Zealand, or in Honduras or at the Cape, when the administrators of our war forces wished for information as regards those countries, they would find the information anywhere else but in the records of this Institution.

Captain Owen, R.A.: With reference to the employment of horses on the West Coast of Africa, it is stated that horses and cattle can live in the neighbourhood of Accra, but not elsewhere in that country. When they get into the bush, they are attacked by the tzetse fly, and gradually die off.

Captain C. D. Miller, R.N.: I do not know much about the shore on the West Coast of Africa, but six years ago I was senior Officer on the West Coast, and from what I heard, it appeared that horses, mules, &c., died from loin disease; they would only live a short time; also that the bush in that country will not fire; it is covered with very dense jungle. (The Chairman: It is disease, not the fly?) I never heard of the tzetse fly being in that district; it may be, but I have never heard it mentioned, only the loin disease. Captain Glover had some thorough bred horses, very small ones, no bigger than ponies, which had been sent down to him from the head Ameer on the River Niger, and they lived because they were born and bred in the country. They were very poor things; but imported horses and mules will not live there.

The Chairman: I quite agree in some respects with what has been said about the discipline of the English soldier. The discipline of the English soldier, I believe, comes out better when he has difficulties to contend with; and the very fact of his

getting back into his quarters without insubordination, shows that there was that real discipline which we all wish to see, and which is indeed established in the English Army. I think the difficulties rather tend to increase that discipline than to mar it. We must all thank Colonel Gawler for his kindness in giving us this lecture. I only wish we could have had more information with regard to the present seat of war, in order to compare it with the very interesting account that we have had of the Kafir war.

The Journal

OF THE

Royal United Service Institution.

Vol. XVII. 1874. Appendix.

PROCEEDINGS OF THE FORTY-THIRD ANNIVERSARY MEETING.

The Forty-third Anniversary Meeting of the Members was held in the Theatre of the Institution, on Saturday, the 7th March, 1874.

Admiral Sir Alexander Milne, G.C.B., Lord of the Admiralty, in the Chair.

Previous to the commencement of the business of the day, the Chairman read a despatch received the night before, announcing the burning of Coomassie, and the return of the troops towards the coast.

I. The Secretary read the notice convening the Meeting.

II. The Secretary read the Minutes of the Forty-second Anniversary Meeting.

III. The Annual Report of the Council was read as follows:—

1. It is with much pleasure that the Council submit their Forty-third Annual Report.

Members.

2. Forty-eight Life, and two hundred and forty-seven Annual Subscribers, making a total of two hundred and ninety-five new Members, joined the Institution during the past year. The loss by death amounted to ninety-four, and thirty-four Members withdrew their names, whilst the names of seven have been struck off the list in consequence of the non-payment of their subscriptions, after frequent applications. The net increase therefore is one hundred and sixty.

A detailed statement of the changes in the List of Members, and a tabular analysis of the past and present state of the Institution, will be found on pages vi and vii. By this analysis it will be seen, that the number of Members at the close of 1873, was greater than at any previous period.

Finance.

3. The usual Abstract of the Yearly Accounts, as audited on the 12th February, will be found on the following page.

GENERAL ABSTRACT OF THE ACCOUNTS OF THE ROYAL UNITED SERVICE INSTITUTION, FROM 1st JANUARY to 31st DECEMBER, 1873.

EXPENDITURE.

	£ s. d.	£ s. d.
Secretary's Salary	300 – –	
Ditto Lodging Allowance	50 – –	
		350 – –
Librarian's Salary		200 – –
Acting Clerk's Salary		79 – –
Fee to Architect		26 5 –
Servants' Wages		470 1 8
Ditto Clothing		47 11 6
Insurance		11 5 –
Ground Rent		202 1 6
Fuel		89 6 6
Lighting		46 13 4
Annuity to John Pitt		20 – –
Assessed and Income Taxes		62 17 3
Parish and Water Rates		97 12 –
Artificers		163 3 7
Museum		99 7 7
Library, Reading, and Topographical Rooms		221 2 3
Advertisements		192 3 11
Printing Circulars and Stationery		161 5 7
Lectures		38 5 6
Journals, including Annual Report and List of Members		1,449 10 6
Postage { Letters	30 3 –	
Postage { Journals	203 12 10	
		233 15 10
House Expenses and Sundries		44 7 8
Cash repaid to Agents		10 – –
Charges from ditto		– 1 11
Balance at Bankers		1 – 2
		£4,316 18 3
For £538 10s. 3 per cent. Consols, Life Subscriptions		500 – –
Balance at Bankers		148 10 –
Total Income and Life		£4,965 8 3

RECEIPTS.

	£ s. d.	£ s. d.
Balance at Bankers, 31st December, 1872		155 8 0
Annual Subscriptions, at 10s.	320 10 –	
,, ,, above 10s.	2,371 15 1	
,, ,, arrears	59 13 –	
,, ,, advance	21 – 6	
Increased Subscriptions, at 10s.	3 10 –	
		2,776 8 7
Entrance Fees		295 3 –
Donation		1 – –
Dividends		291 19 2
Interest on Exchequer Bills		21 10 4
Government Grant		600 – –
Sale of Journals		173 6 2
Miscellaneous Receipts		2 3 –
		£4,316 18 3
Balance of Life Subscriptions at Bankers, 31st December, 1872		113 10 –
Life Subscriptions		535 – –
Total Income and Life		£4,965 8 3

Examined and found correct, 12th February, 1874.

J. E. A. DOLBY
TOB. G. RIDGWAY } Auditors.

T. D. SULLIVAN, Accountant.

Estimate of Receipts and Expenditure for the Year 1874.

Expenditure.

	£	s.	d.
Secretary's Salary and Lodging allowance	350	–	–
Librarian and Accountant's do.	200	–	–
Acting Clerk's do. ..	80	–	–
Servants' Wages	500	–	–
Ditto Clothing ..	50	–	–
Insurance	11	5	–
Ground Rent	205	–	–
Fuel	100	–	–
Lighting	50	–	–
Assessed and Income Taxes	100	–	–
Parish and Water Rates	110	–	–
Artificers, Repairs, &c. ..	150	–	–
Museum	150	–	–
Gold Medal (Dies) ..	100	–	–
Library and Topographical Departments	250	–	–
Advertisements	150	–	–
Printing Circulars, & Stationery	180	–	–
Lectures	50	–	–
Journals	1,000	–	–
Postage of Journals ..	250	–	–
Postage	60	–	–
Printing Annual Report and List of Members ..	50	–	–
House Expenses and Sundries	60	–	–
Balance ..	83	15	–
Total.. ..	£4,290	–	–

Receipts.

	£	s.	d.	£	s.	d.
Balance at Bankers, 31st Dec., 1873				150	–	–
Annual Subscriptions :						
At 10*s*. ..	320	–	–			
Above ..	2,500	–	–			
				2,820	–	–
Entrance Fees				250	–	–
Dividends				300	–	–
Interest on Exchequer Bills				20	–	–
Government Grant ..				600	–	–
Sale of Journals				150	–	–
Total.. ..				£4,290	–	–

Life Subscriptions.

4. Life Subscriptions to the amount of £500, including £113 10*s*. not invested last year, have been invested in Three per Cent. Consols.

Capital Account.

5. The funded property of the Institution on the 1st January, 1874, was £9,465 2*s*. 4*d*., as compared with £8,926 12*s*. 4*d*. on the 1st January, 1873.

The Future Locality of the Institution.

6. Although the Council have every reason to expect a satisfactory solution of this question, they are unable to make any report with reference to it, whilst the disposition of the Crown lands in, and adjoining Whitehall, is still under consideration.

Lectures and Journal.

7. Thirty-two Lectures were delivered, and sixteen Papers were read in the Theatre, last season. Of these, eight Lectures were delivered to Officers of the Artillery Volunteers, and six to Officers of the Rifle Volunteers. The former series has been published by the National Artillery Association, the latter by this Institution.

Upwards of 21,000 numbers of the Journal, containing more than 130,000 Maps, Diagrams, and Plans, have been distributed to the Members (6,000 by hand, and 15,000 by post), while 833 numbers have been sold. It is gratifying to find that the sale of the Journal has been considerably larger than at any former period.

This large issue has caused a considerable increase of expenditure, hich the Council do not regret, feeling convinced that the diffusion of professional knowledge cannot be better secured, than by the circulation of carefully edited, and liberally illustrated, Papers and Discussions.

In no former year, have subjects more varied in character, or more important in their bearings, been submitted for the consideration of the Members, and the Council tender their thanks to all who have contributed so much valuable information.

Library.

8. Four hundred and sixty-six volumes were added to the Library during the past year; of these, 262 were purchased, and 204 presented. Among the latter, the following are the most noteworthy:—

By the Austrian Government—
- *Der Krieg in Italien*, 1859.
- *Mittheilungen über Gegenstände des Artillerie- und Genie-Wesens.*
- *Mittheilungen aus dem Gebiete des Seewesens.*
- *Organ des Wiener Militär-wissenschaftlichen Vereines.*

By the Danish Government—
- *Three Sheets of the Topographical Atlas of Denmark.*

By the French Government—
- *Revue Maritime et Coloniale.*
- ,, *Militaire de l'Etranger.*

By the German Government—
- *Archiv für die Artillerie- und Ingenieur- Offiziere des Deutschen Reichsheeres.*
- *Jahrbücher für die Deutsche Armee und Marine.*
- *Militärische Blätter.*
- *Militair- Literatur- Zeitung.*

By the Italian Government—
- *Rivista Militare.*
- *Rivista Marittima.*

By the Russian Government—
- *Engineering Journal.*
- *Naval Review.*

By the SPANISH Government—
Memorial de Ingenieros.

By the SWISS Government—
3rd Part of the Topographical Atlas of Switzerland.

By the UNITED STATES Government—
Eleven Volumes on Military and Naval subjects.

The exchange of Journals with Foreign Governments, and with various Scientific Societies, in this and other Countries, has been continued.

The Library now contains 16,227 volumes.

TOPOGRAPHICAL DEPARTMENT.

9. The Secretary of State for War has presented Photographs and Lithographs of Guns, Casemates, Shields, Targets, &c.

The Institution has also received from the Lords Commissioners of the Admiralty, Charts, Sailing-Directions, &c.

MUSEUM.

10. Half-block Models of H.M. Ships "Fury," "Superb," and "Temeraire" have been ordered; and a Model of the 9-inch Moncrieff Gun Carriage has been purchased for the Museum.

Various additions (some of much interest), have been made by presentation; these will be found recorded in the Proceedings of the Anniversary Meeting, and in Appendix to Vol. 17 of the Journal. The thanks of the Council have been tendered to the Secretaries of State for War and of India, to the Lords Commissioners of the Admiralty, and tc the several donors, for their respective contributions.

VICE-PATRON.

11. The Council regret to record the death of one of the Vice-Patrons of the Institution, Admiral the Right Hon. the Earl of Hardwicke, D.C.L., F.R.S. The late Earl became a Member of the Institution in 1835, and was elected a Vice-Patron in 1840.

VICE-PRESIDENT.

12. By the death of General C. R. Fox, late Colonel 57th Regiment, the Institution has been deprived of one of its earliest Members and warmest supporters. General Fox served on the first Council of the Institution in 1831, and was elected a Vice-President in 1840.

The Council have had the pleasure of electing, as a Vice-President, Captain Edmund Packe, late Royal Horse Guards, who had served on the Council many years.

Honorary Members.

13. The Council have elected Lieut.-Col. Roerdansz, of the Prussian Staff, and formerly Military Attaché to the North German Embassy in London, an Honorary Member of the Institution: several other Foreign Officers were also elected Honorary Members during their stay in this country.

Corresponding Members of Council.

14. The number of Corresponding Members of Council on the 1st January, 1874, was 353, as compared with 349 on the 1st January, 1873.

The Council tender their thanks to their Corresponding Members, and especially to those who have been most energetic and successful in inducing their brother Officers to join the Institution.

Gold Medal.

15. The Council have decided that a Gold Medal be granted annually for the best Essay on a Naval or a Military subject, to be determined on, each year, by the Council. The subject for the ensuing year will be of a Military character. The Medal will be presented to the successful competitor at the Anniversary Meeting.

Conclusion.

In concluding this, their Forty-third Annual Report, the Council congratulate the Members on the satisfactory condition of the Institution.

Statement of Changes among the Members since 1st January, 1873.

			Life.	Annual.	Total.
Number of Members, 31st December, 1872 ..			1,009	3,107	4,116
,, ,, joined during 1873 ..			48	247	295
			1,057	3,354	4,411
Changed from Annual to Life			+14	−14	
			1,071	3,340	4,411
	Life.	Annual.			
Deduct—Deaths during 1873 ..	20	74			
Withdrawals ..	—	34			
Struck off	—	7			
	20	115	20	115	135
Number of Members on 1st January, 1874 ..			1,051	3,225	4,276

Tabular Analysis of the State of the Institution,

To 31st of December, 1873.

Year. 1st Jan. to 31st Dec.	Annual Subs. received.	Entrance Fees.	Income (from all sources).*	Life Subs. received.	Amount of Stock	Invested in the purchase of Books, &c.	No. of Vols. in Library.	No. of Members on the 31st Dec.	Number of Visitors
	£	£	£	£	£	£			
1831	654	..	654	1,194	..	..	..	1,437	..
1832	1,146	..	1,146	973	..	..	..	2,699	..
1833	1,405	..	1,450	692	..	..	..	3,341	..
1834	1,500	..	1,549	583	1,100	..	..	3,748	13,376
1835	1,480	..	1,574	366	2,430	40	..	4,155	8,537
1836	1,570	..	1,682	330	3,747	45	..	4,069	8,521
1837	1,549	..	1,747	222	4,747	180	..	4,164	10,907
1838	1,462	..	1,634	230	5,500	246	..	4,175	15,788
1839	1,399	..	1,565	168	5,500	292	..	4,186	16,248
1840	1,363	..	1,525	198	5,500	446	5,500	4,257	17,120
1841	1,450	..	1,643	186	6,000	243	5,850	4,243	19,421
1842	1,373	..	1,565	144	6,400	373	6,450	4,127	21,552
1843	1,299	..	1,494	140	6,700	237	7,000	4,078	27,056
1844	1,274	..	1,408	112	3,000	298	7,850	3,968	22,767
1845	1,313	..	1,466	228	1,500	127	8,100	3,988	21,627
1846	1,298	..	1,456	138	1,500	74	8,410	4,031	32,885
1847	1,314	74	1,502	132	1,700	37	..	4,017	38,699
1848	1,175	57	1,375	48	1,700	85	9,641	3,947	37,140
1849	1,176	72	1,375	84	1,150	58	..	3,970	33,333
1850	1,141	106	1,294	198	600	36	..	3,998	33,773
1851	1,136	131	1,292	66	666	34	10,150	3,188	52,173
1852	1,134	133	1,281	114	200	43	10,300	3,078	20,609
1853	1,243	319	1,684	264	528	41	10,420	3,251	25,952
1854	1,200	138	1,368	126	612	95	10,587	3,171	22,661
1855	1,159	107	1,289	120	653	55	10,780	3,131	14,778
1856	1,216	197	1,519	156	761	47	10,832	3,204	16,184
1857	1,258	176	1,937	78	1,038	40	10,960	3,168	12,755
1858	1,318	221	2,102	105	438	31	11,062	3,246	25,747
1859	1,526	195	2,277	512	946	70	11,320	3,344	28,739
1860	1,961	298	3,577	397	2,178	114	11,517	3,518	28,011
1861	2,122	305	2,899	266	2,846	99	11,812	3,689	23,296
1862	2,296	242	3,127	239	3,178	109	12,026	3,797	27,215
1863	2,379	218	3,100	405	3,583	143	12,296	3,847	18,150
1864	2,425	215	3,253	222	4,516	116	12,700	3,902	17,276
1865	2,435	154	3,467	235	4,804	137	13,000	3,895	18,253
1866	2,435	157	3,488	299	5,486	150	13,337	3,891	17,067
1867	2,431	141	3,467	208	5,732	140	13,800	3,823	17,211
1868	2,446	184	3,534	297	6,396	119	14,100	3,812	16,417
1869	2,368	165	3,485	238	6,653	232	14,660	3,792	15,947
1870	2,376	178	3,493	333	7,313	140	15,055	3,831	18,654
1871	2,455	237	3,677	538	7,748	202	15,501	3,922	19,420
1872	2,620	336	4,111	713	8,927	192	15,761	4,116	19,773
1873	2,776	295	4,316	535	9,465	222	16,227	4,276	18,183

* Including Annual Subscriptions, Entrance Fees, Donations, Legacies, and Interest on Funded Property and Grant from Government, commencing in 1857.

IV. Lieutenant-General the Hon. Sir ALEXANDER HAMILTON-GORDON, K.C.B.—

I rise to propose the first Resolution, viz.:—

"That the Report now read be adopted, and printed for circulation among the Members."

We may congratulate ourselves, Gentlemen, on the continued prosperity of the Institution. For upwards of forty years it has gone on increasing in importance, both by the number of the Members joining it, and by the amount of subscriptions received. The statement of accounts, also, is satisfactory, inasmuch as the expenditure is within the receipts, although the balance at the bankers is certainly not large. It is to be regretted, I think, that the Council cannot report that anything is absolutely settled with regard to the future locality of the Institution; but I believe I may say, that the Government Surveyor has been permitted to put upon a proposed plan for the laying out of the Crown lands in this neighbourhood, a site for the Institution. It does not bind the Government to anything, and does not show that we shall get the site, but still it is a step gained. There is another point on which we may congratulate ourselves, namely, on the increased value and importance of the Papers which appear in the Journal. During the last two or three years they have very much improved in their character. This year, especially, there have been Papers of great interest, both on Naval and Military subjects. I think the publication in the Journal of one of the Essays from the Staff College, Sandhurst, a very good step, and if that practice is continued, it will, I think, be to our own benefit, and will also connect us with Sandhurst, which is desirable. There is another step the Council have taken, viz., with regard to instituting a Gold Medal, which the Members will doubtless highly approve of. This Medal is to be given annually for the best essay, alternately, upon Naval and Military subjects. A difficulty will arise in awarding the prize, and it depends entirely on the care which is taken in so doing, whether the experiment will prove successful. I think the Council cannot do better than associate themselves with the authorities at Sandhurst in that way, for it will tend still further to connect us with that Institution. I beg to move the adoption of the Report.

The Resolution having been seconded by Vice-Admiral Sir WALTER TARLETON, was put from the Chair and was carried unanimously.

V. The names of the eight Members retiring by rotation from the Council were read as follows:

Vice-Admiral the Right Hon. Sir JOHN C. DALRYMPLE HAY, Bart., M.P. &c.
Major WILSON, R.E.
W. F. HIGGINS, Esq.
Vice-Admiral RYDER.
Captain NOLLOTH, R.N.
Captain GOODENOUGH, R.N.
Major KNOLLYS.
Major-General F. EARDLEY-WILMOT R.A., F.R.S.

Colonel the Right Honourable Lord WAVENEY, F.R.S.—

The Resolution I have to propose is one which will require very little preface, and, in fact, we may almost anticipate it by the feelings of the Meeting:—

"That the thanks of this Meeting be given to the Members who retire from the Council by rotation."

Before I proceed, I beg to express my sense of the additional value that the Members of the Council have given to their services by the step that has been taken in offering a Gold Medal for competition. It appears to me to have this special value, that it will be a Gold Medal for either service, given to officers who have served,

or may have to serve, and who are aware of the difficulties that beset the combination of our forces in this country. Further, I have to move, "That the following Members be elected to fill the vacancies, viz.:

Vice-Admiral Sir J. C. D. Hay, Bart., M.P. } For Re-election.
Major C. W. Wilson, R.E. } For Re-election.
W. F. Higgins, Esq. } For Re-election.
Lieut.-Col. Lord Wm. F. Seymour.
Admiral Sir Henry J. Codrington, K.C.B.
Vice-Admiral Sir J. W. Tarleton, K.C.B.
Captain Mayne, C.B., R.N.
Colonel the Hon. F. Thesiger, C.B., A.D.C.

"And that the following names be adopted from which vacancies, in the event of their occurring, may be filled", viz.:—

Major-General Sir Richard Wilbraham, K.C.B.
Colonel Sir W. Henry R. Green, C.B., K.C.S.I.
Rear-Admiral Frederick Campbell.
Major-General J. L. Vaughan, C.B.
Lieutenant-Colonel Aikman, V.C.
Major Crossman, R.E."

Captain Hoseason, R.N.—

It is with much pleasure that I rise to second the motion, and I feel that I should be failing in my duty if I did not say a few words to those gentlemen who have taken so laborious a charge on their hands, and who are now retiring from the Council. Every one who looks at the excellent Papers that have been read, must know that we are indebted to the Members of the Council, not only for the selection of the various subjects, but also of the people to write them; the Members who are about to retire, must feel therefore that indirectly they have been the source of communicating very valuable information to our profession. I therefore beg to second the motion which the Noble Lord has proposed.

The Resolution was then put from the Chair, and was carried unanimously.

VI. Admiral Sir Henry Codrington, K.C.B.—

Very few words are required for a Resolution of this kind. I have to propose—

"That the thanks of this Meeting be given to the Auditors for their valuable services, and that the following gentlemen be elected for the ensuing year:—

T. G. Ridgway, Esq., for Re-election.
Thomas Smith, Esq.
Captain J. E. A. Dolby."

The Meeting will I think feel that, however well our accounts have been kept (and they certainly have been well kept, and very successfully brought before us), something more is wanted, namely, that they shall be well audited. This duty has been well performed by these gentlemen, and it is due to them that we should thank them. I therefore have great pleasure in proposing that the thanks of this Meeting be given to the Auditors who have served us so well, and propose that they be elected Auditors for the ensuing year.

The Resolution having been seconded by General Craufurd, was put from the Chair, and was carried unanimously

The CHAIRMAN—

Gentlemen, we have heard to day that it is the intention of the Council,—and it has been submitted to the Meeting,—to grant annually a Gold Medal. That Resolution appears to have received approval from all here, and I am sure it does not require any words from me to recommend it. I believe that nothing will add so much to the interests of this Institution, and so much to the character of the papers, and to the credit of those gentlemen who will have the honour of receiving that Medal, as the step which has been now taken. The subject for the Gold Medal Essay for this year is as follows, viz. :—" On the best mode of providing Recruits, and forming Reserves, for the British Army; taking into consideration its varied duties in peace and war."

The Chair having been taken by Colonel STEPHENSON, Chairman of the Council—

Sir WILLIAM CODRINGTON said—

I beg to propose that the thanks of this Meeting be given to Sir Alexander Milne for his kindness in attending here to-day and taking the Chair at our Anniversary Meeting. We have generally succeeded at our Annual Meetings in obtaining the attendance of one of the Cabinet Ministers connected either with the Army or the Navy, to identify himself with the well-being of this Institution. Very possibly on the present occasion, in consequence of the recent change in the Ministry and the pressure of public business on the First Lord of the Admiralty, we are favoured with the presence of one of the executive officers of the Navy. I am sure that we thank any officer of his high rank, who takes an interest in the Institution. It has won its way by sheer work, that is to say by doing that which is of great consequence to the profession, namely, by free discussion on all subjects, both naval and military, —sometimes, perhaps, a little disagreeable to the Government,—but in no case, I believe, over-stepping the fair bounds of discussion. That is a very great point to be maintained, and every person who comes here to lecture should feel at perfect liberty to give his opinion—even though differing with the authorities—so long as it is done in a gentlemanly and officer-like manner. I need not detain this Meeting except to say, that we hope Sir Alexander Milne represents the head of the Navy as taking an interest in this Institution. I have no doubt that he, in his position as one of the Admiralty, will echo my feeling, namely, success to the Institution. I beg to propose a vote of thanks to Sir Alexander Milne.

Sir JOHN HAY.

Mr. Chairman, my Lords, and Gentlemen, I rise to second the Resolution which has just been proposed, and I do so with great pleasure. My gallant friend will remember that we cannot always have Cabinet Ministers to fulfil the function which has been so ably performed by Sir Alexander Milne to-day; and I venture to say that there is a feeling in this Institution, that however glad we may be to see distinguished Ministers of State here, we are equally glad, and quite as proud of our profession, when we see here distinguished officers like the gallant General who has proposed the resolution, who has distinguished himself in the field, or my equally distinguished friend, Sir Alexander Milne, who at sea and in the administration of this country, has shown what the officers of the Army and Navy can do, both in civil life and on active service. I am quite sure that he will speak also on behalf of my Right Honourable friend, Mr. Ward Hunt, in stating that the practical information (derived from Papers and discussions) afforded to the Government by this Institution, will be gratefully received by him. I therefore second my honourable and gallant friend in proposing a vote of thanks to Sir Alexander Milne for the way in which he has performed his duty here to-day; and I trust that he, in the Administration, will do his best to get that site which the gallant general (Sir Alexander Hamilton-Gordon) has said is already proposed on certain plans, for submission to her Majesty's Government.

The Resolution was then put from the Chair and was carried with acclamation.

Sir Alexander Milne—

My Lords and Gentlemen, I beg to thank you for the honour you have done me in according me a vote of thanks. I can only say that I am exceedingly grateful to the Council for having done me the honour of asking me to preside on this occasion. I accepted that invitation with the greatest pleasure; because, though I have not been participating as an active Member in this Institution, yet it is one that I have for years advocated as one of the most useful and practical for both Services. I have read with great attention, and with much interest, the valuable Journals which are published here. They contain matters of public interest both for the Army and Navy, as well as for civil life, and I can certainly concur in all that has been said to-day about our being under a deep obligation to the authors of those Papers for the address which they have displayed, and for the ability with which they have written them. But the usefulness of this Establishment is not confined to the discussions which take place here. I agree in every word which the gallant General said with regard to free discussion. I think it is for the interest of our professions that those who come here should clearly and explicitly state their views in that straightforward manner which cannot be objectionable to any Government. Besides the privilege of the Lectures, Members of this Institution have access to what is perhaps the finest professional library in the country. It is a great credit to the Members of the Council, and to those who have passed years in the discharge of their duties here, that this Establishment has been raised to the position which it now holds, that it has the finest library in the country, that it receives from foreign nations their principal works, and that both the War Office and the Admiralty are ready to come forward to render such assistance as they can in the way of books and charts. There is another way in which this Institution exercises a widespread influence. I believe that the Papers published here, have great influence in our respective professions; and I find that the junior officers of the Fleet have themselves established at Portsmouth a professional association founded on the principles of the Royal United Service Institution. They have united together for the purpose of discussing matters connected with the Service, and have published journals in the same manner as this Institution has done. But they have gone further—they have not yet come to a Gold Medal—but even in their infancy they offered a prize of £50 for the best Essay on Naval Evolutions and Naval Tactics. I think their having taken this step so creditable to those young men, that I take this opportunity of mentioning the subject with great pleasure and satisfaction. Thirteen Essays were sent in, and I was asked, in conjunction with Sir Cooper Key and Admiral Ryder, to decide which was the best. After considerable labour and time, we found that the Essay written by Lieut. Noel of the Navy, now serving in the "Active," on the coast of Africa, merited the prize, and it has accordingly been awarded to that officer. I have pleasure in mentioning that, because the Essay, which is now printed, does him great credit; and I also take the opportunity of referring to the subject as showing the influence that this Institution has over the professional officers of the Navy, and I believe of the Army also. I have to return you thanks for the compliment paid to me, and to assure you that my desire and my anxiety have been to forward the interests of our respective professions, and also to do all I could for this Institution. Before I resume my seat, I should allude in a few words to some changes which appear to have taken place. We have to regret the loss of two distinguished officers—one of the Navy and one of the Army. I think it would be unbecoming on my part in returning thanks for the honour you have done me, if I did not express a word of regret in your name for the loss of Admiral the Earl of Hardwicke, who was a Vice-Patron, and also of a personal friend of my own, well known to you all, General Fox, late Colonel of the 57th Regiment.

I trust that you will accept my thanks for the honour you have done me.

DONATION IN 1873.

P. Q. R., £1.

NAMES OF MEMBERS

WHO JOINED THE INSTITUTION BETWEEN THE 26TH JUNE AND 31ST DECEMBER, 1873.

LIFE.

Wilson, Belford R., Sub-Lieut. 13th Hussars.
Wood, Hon. F. L., Capt. R.N.
Douglas, Charles, Colonel R.A.
Bray, G. F. C., Lieut.-Col. 96th Regt.
Startin, R. F. P., Lieut. 10th Hussars.
Walker, H. Chesshyre, Lieut. R.A.
Boyd, Archd. D., Capt. 1st Roy. E. Middlesex Mil.
Arthur, Albert F., Midshipman R.N.
Sanderson, Patrick, Capt. 2nd Rl. N. B. Dragoons.
Brown, W. E., Lieut. 15th Regt.
Sapieha, J. P. A. Prince, Lieut. 5th Dragoon Guards.
Armstrong, Sir Alexander, K.C.B., M.D., LL.D., F.R.S., &c.
Gloag, A. R., Colonel R.A.
Vyse, E. Howard, Colonel 3rd Hussars.
Beamish, Caulfield F., Captain late 45th Regt.
Lumsden, P. S., C.B., C.S.I., Col. Bengal Staff Corps.
Currie, Wm., of Linthill, Lieut. late Edin. Militia.
Crawford, Alex. de C., Lieut. R.N.

ANNUAL.

Cope, Sir Wm. H. Bart., late Lieut. Rifle Brigade.
Johnston, Alex. Campbell, Esq., late Govr. Hong Kong.
Crookshank, Arthur, Capt. Bengal Staff Corps.
Bradshaw, R. A., Captain R.N.
Bradshaw, F. Boyd, Lieut. 13th Regt.
Wace, R., Lieut. R.A.
MacFarlan, D., Lieut.-Col. R.H.A.
Brunel, Alfred, Lieut.-Col. Canadian Active Mil.
Inglis, R. W., Lieut. London Irish R.V.
Codrington, Alfred E., Sub.-Lieut. Coldstream Gds.
Jephson, Alfred, Lieut. R.N.
Loch, William, Capt. 19th Bengal Cav.
Eyre, F. V., Major R.A.
Milner, Joseph, Midshipman R.N.
Ross, of Bladensburg, J. F. G., Lieut. Coldstream Guards.
Samson, A. M. W., Capt. 1st W. I. Regt.
Woods, J. A., Major h. p. Madras Army.
Oldfield, Geo. T., Capt. Roy. Lond. Mil.
Hutton, C. M., Sub-Lieut. 52nd Regt.
Hardtman-Berkeley, J. H., Lieut. 83rd Regt.
Wirgman, Theodore, Colonel late 6th Dragoons.
Lazenby, James, Major 100th Regt.
Stawell, Geo. D., Lieut. 11th Regt.
Walkey, R., Captain R.A.
Neilson, W. M., Lieut.-Col. 25th Lanark R.V.
Nugent, Andrew, Lieut.-Col. 2nd Royal N.B. Dragoons.
Scott, Geo. T., Lieut. 2nd Royal N.B. Dragoons.
Alexander, Hon. W. P., Lieut. 2nd Rl. N.B Dragoons.
Farquhar, F. G., Capt. 2nd Royal N.B. Dragoons.
Henry, J. L. V., Lieut. 2nd Royal N.B. Dragoons.
Frimstone, W. F., Lieut. 2nd Royal N.B. Dragoons.
Doherty, Chas. W O., Lieut. 2nd Royal N.B. Dragoons.
Russell, Hon. Geo. W. G., Lieut. 9th Royal Lancers.
Moore, John, Lieut. 6th Dragoon Gds.
McMahon, Alex. R., Lieut.-Col. Madras Staff Corps.
Huntingford, E. W., Lieut. 1st West India Regt.
Churchill, Lord E. S., Lieut. Isle of W. Militia.
Prior, H. Wallis, Lieut. 81st Regt.
Twemlow, Edw. D'O, Capt. R.E.
Davis, John, Capt. 2nd Surrey Mil.

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Kellie, Robt. H., Lieut. 82nd Regt.
Berkeley, George, Esq., Governor, West Africa.
Dunne, T. J. B., Lieut. 2nd Queen's Regiment.
Johnson, H. J., Lieut. 80th Regt.
Thurlow, E. H., Lieut. 60th Rifles.
Mortimer, C. L., Lieut. 7th Rl. Fusiliers.
Borton, A. C., Lieut. 13th Regt.
Wavell, A. G. Lieut. 9th Regt.
Grogan, E. G., Lieut. 42nd Highlanders.
Rickards, A. W. L., Lieut. 1st Rl. Scots Regiment.
Randolph, Edmund, Lieut. 69th Regt.
St. Clair, J. L. C., Lt. 91st Highlanders.
Onslow, W. W. R., Lieut. 12th Regt.
Slack, James, Lieut. Adj. School of Musketry.
Warren, John, Capt. N. Mayo Mil.
Coppinger, T. S., Lieut. 11th Regt.
Dawes, Thomas, Capt. Beng. Staff Corps.
Duckett, W. M., Lieut. 21st Regt.
Kelly, J. G., Lieut. Bengal Staff Corps.
Cautley, George, Major-General Unatt.
Fitzroy, F., Major R.A.
Whitwell, John, M.P., Lt.-Col. Westmoreland R.V.
Hunt, W. G. F., Assist.-Paymaster R.N.
Blackett, E. U., Lieut. R.A.
Johnstone, M. Geo. Lieut. 2nd Rl. N.B. Dragoons.
D'Aguilar, Charles L., C.B., Major-Gen. R.A.
Cameron, J. C., M.D., D. I. G. of Hospitals.
Gosling, W. C. F., Colonel R.H.A.
Prattent, F. M., Captain R.N.
Innes, Percival R., Lt.-Col. late Indian Army.
McCausland, M. F. H., Capt. R.A.
Mackenzie, John Kenneth, Lieut.-Col. Unatt.
White, David, Lieut. R.N.R., late Indian Navy.
Fawkes, Wilmot H., Lieut. R.N.
Gordon, C. S. S. Evans, Col., Gov. R.V. Hospital.
Leake, H., Capt. East York Mil., late 70th Regt.
Harvey, E., Capt. R.E.

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Adams, W. Marsham, Esq. Handbook of the Cœlometer. Pamph. *n.d.*

Ditto. Handbook of the Mensurator. Pamph. *n.d.*

Ditto. Outlines of Geometry, or the motion of a point, an introduction to Euclid's Elements. 3rd Revised Edition. *n.d.*

Ditto. The Problem of Pythagoras. *The Author.*

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Ditto. W. S. Feathering Propellor. Pamph. 1873.

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Andrew, W. P., Esq. On the completion of the Railway System of the Valley of the Indus. Pamph. 1869. *The Author.*

Anon. The March of an Army Corps. Pamph. 1873. *Anon.*

Ditto. The War Office and the Volunteer Force. Pamph. 1873. *Anon.*

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Army Estimates from 1801 to 1872. Fol. *The Secretary of State for War.*

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Bengal. Medical Report. Native Army, 1870–71. Fol. *K. McLeod, Esq., A.M., M.D.*

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Colonel Fletcher, Scots Fusilier Guards,
Military Sec., &c.

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